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NATIONAL MUSEUM MELBOURNE

The Journal of the Department of Agriculture of Victoria, Australia.

May, 1924.

PRINCIPAL CONTENTS

Development of Grass Lands

Wheat and its Cultivation

Crop and Fallow Competitions

Annual Report—Horse Breeding Act

Tobacco Culture

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THE JOURNAL

OF

THE DEPARTMENT OF AGRICULTURE,

VICTORIA, AUSTRALIA.

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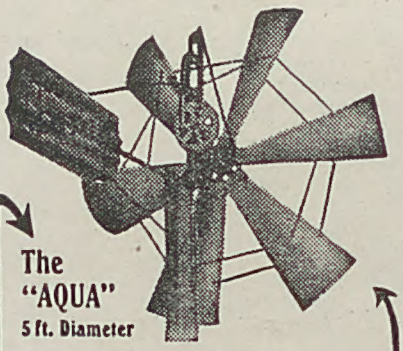

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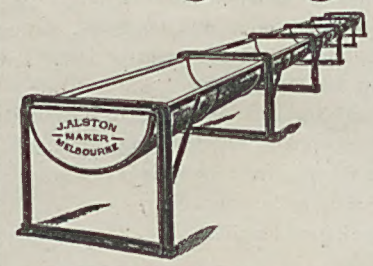

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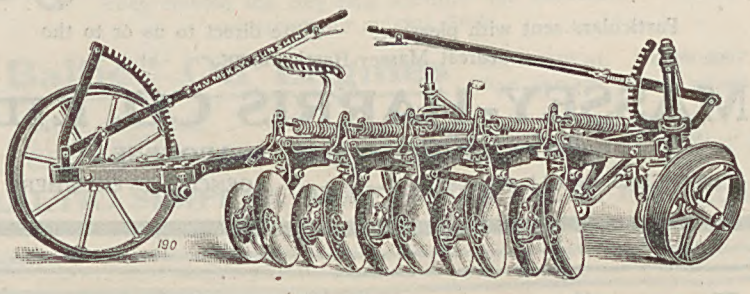

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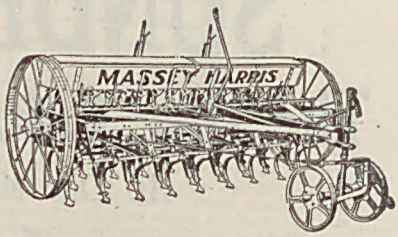

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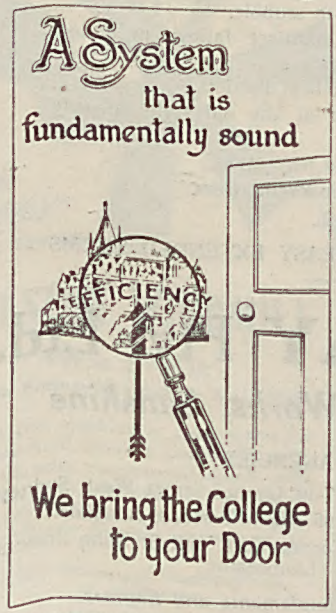

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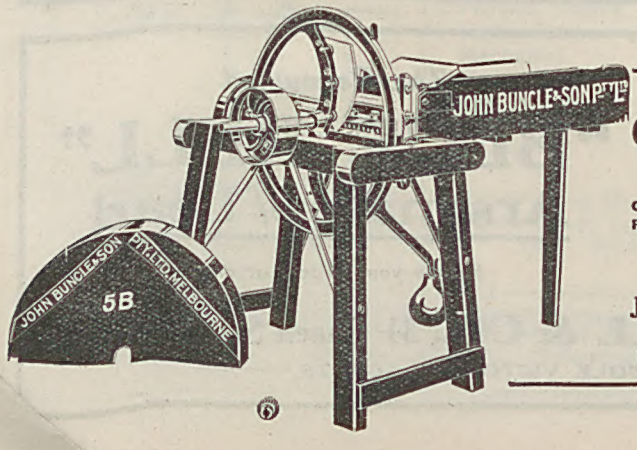

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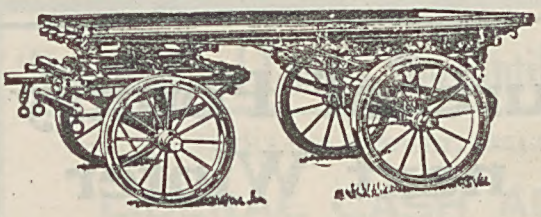

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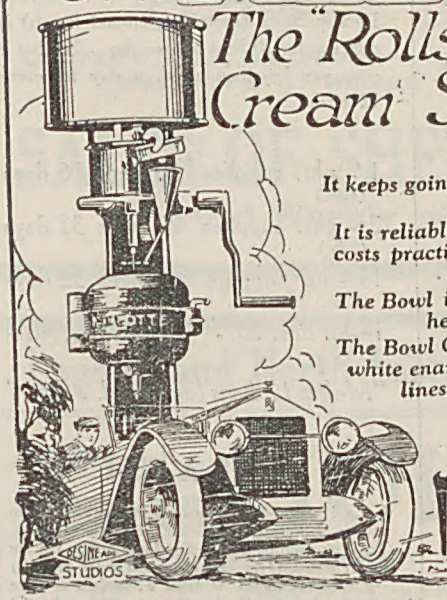

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DEVELOPMENT OF GRASS LANDS.

(Continued from p. 193.)

By A. E. V. Richardson, M.A., D.Sc., Agricultural Superintendent.

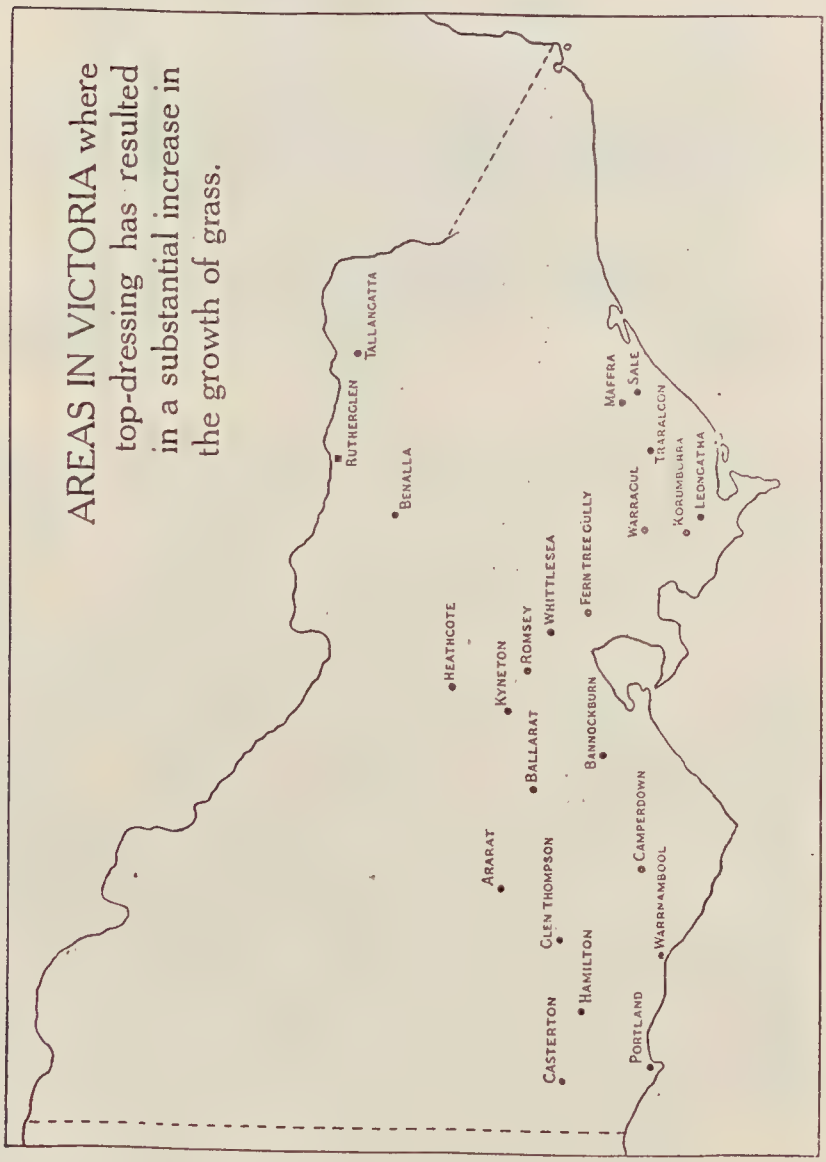
Experiments by the Chamber of Agriculture.

A number of top-dressing tests were conducted during 1923 under the auspices of the Chamber of Agriculture. Over 30 of such plots were laid out on a uniform plan—(*a*) No manure; (*b*) 1 cwt. superphosphate; (*c*) 2 cwt. superphosphate per acre. In practically all cases substantial increases were recorded on the plots treated with superphosphate.

The centres recording substantial improvement in the pastures as a result of top-dressings were as follow:—Ararat, Ballarat, Benalla (two centres), Casterton, Camperdown, Heathcote, Korumburra, Kyneton (two centres), Leongatha (two centres), Maffra, Portland, Romsey, Sale, Tallangatta (three centres), Traralgon, Warragul (two centres), Warrnambool (two centres), Whittlesea, and Yea. The only centre where top-dressing did not show an increase was Euroa.

The annual rainfall of these centres varies from 18 to 40 inches. No tests were made on the lighter rainfall country, though there is reason to believe that dressings of water-soluble phosphates would give a profitable response on the natural pastures in the Wimmera and the northern areas. Experiments on private farms in the Wimmera during the past year have shown that substantial improvement in the carrying capacity of the grass land results from top dressing.

Space will not permit a review of these tests, but reference may be made to that carried out in the Kyneton district, where the results for two years are available. They are of special interest, in view of the fact that each year the plots were cut with a mower, and the grass-hay


AREAS IN VICTORIA where top-dressing has resulted in a substantial increase in the growth of grass.
RUTHERGLEN
TALLANGATTA
BENALLA
HEATHCOTE
KYNETON
ROMSEY
WHITTLESEA
FERN TREE GULLY
BALLARAT
BANNOCKBURN
ARARAT
GLEN THOMPSON
HAMILTON
CASTERTON
PORTLAND
CAMPERDOWN
WARRNAMBOOL
WARRAGUL
MAFFRA
SALE
TRARALGON
KORUMBURRA
LEONGATHA

dried and weighed over the municipal weighbridge. In this way a fairly accurate estimate of the value of the top-dressing was obtained.

The results were as follows:—

Table VI.—Showing Weight of Dry Grass Hay per Acre on Top-Dressed Plots, Kyneton, 1922-1923.

Plot.	1922.	1923.	Average for Two Years.
	cwt.	cwt.	cwt.
No manure	8·0	19·25	13·62
Superphosphate 1 cwt. per acre ..	15·87	27·5	21·68
Superphosphate 2 cwt. per acre ..	26·0	44·0	35·0

The plots were sown on separate paddocks each year, and the soil was representative of the average land of the district. The rainfall for 1922 was 22.51 inches, and for 1923 30.26 inches. The value of the grass hay—which was sold at £3 per ton—on the unmanured plot averaged for the two years £2 0s. 10d. per acre, while that on the heavily manured plot was worth £5 5s. per acre. This increase was obtained for an expenditure of 12s. per acre, being the cost of the fertilizer and its application.

There was a remarkable growth of clover and trefoil on the manured sections of these plots.

The majority of the farmers who conducted the demonstration tests for the local societies, in co-operation with the Chamber of Agriculture, have displayed a fine public spirit, which is most admirable. In many cases they fenced off the areas on which the experiments were conducted, and made careful records of their progress and secured data on which to base estimates of the yield of grass from each dressing.

Relationship Between Chemical Composition of the Soil, and the Character of the Mixed Herbage Growing on the Soil.

A close relationship exists between the chemical composition of the soil and the character of the grass grown on the soil. That the growth and quality of grass is an indicator of the fertility of the soil is well known. The practical man judges the value of land mainly by its capacity to grow grass.

Our soils, as a whole, are known to be deficient in available phosphoric acid. Moisture supply and soluble phosphates may be regarded as the two most important limiting factors in the growth of crops and grass over the southern portion of the continent.

Kincaid* has shown that Australian grasses have a markedly lower phosphoric acid content than those of Europe, and that acclimatized European grasses have a much higher phosphorus content than native Australian grasses, but lower than the same kinds of grasses grown in Europe. In the same paper it was shown that the wood of Australian trees has a lower phosphate content than that of European trees.

These facts appear to indicate that the low phosphate content of Australian grasses and Australian herbage is a reflex of the environment

* The Biochemical significance of Phosphorus—Hilda Kincaid. Proc. Royal Society Victoria v 23. p. 363, 1911.

in which they grow, i.e., the deficiency of phosphate in the soil produces a vegetation which, compared with that of other countries, is low in phosphates.

Phosphoric acid is a most important substance in animal nutrition. In combination with lime and magnesia, it forms 85 per cent. of the ash of bones, and the ash of muscular and nervous tissue contains approximately 35 per cent. of phosphoric acid. All tissues provided for the maintenance of the young are very rich in phosphorus, e.g., eggs, milk.

The experiments of Hart, McCollum, and Fuller (*American Journal of Physiology*, XXIII., 1908-9) showed that animals fed on foods deficient in phosphates soon became abnormal, exhibiting weakness of limbs and debility; whilst if the diet were made normal again the animals gradually recovered. Cattle living on natural foods poor in phosphate of lime often suffer from a form of paralysis.

Soils deficient in phosphates produce grass with a low content of phosphates. Such phosphate-starved grass will inevitably produce phosphate-starved animals which will become unprofitable to their owners. Can this be avoided? If the deficiency of soluble phosphate is made up by the liberal application of water-soluble phosphate, will the grass grown on such soil show increased phosphate content?

On this important point, some very definite evidence is available from the Rothamsted Experiment Station.

One of the most noticeable results of the manuring of permanent grass lands with various artificial manures is to markedly change the proportions of gramineous, leguminous, and miscellaneous herbage in the pasture. Hence, if we desire to test the changes in the chemical composition of the herbage as a result of manuring, it is necessary to separate these three types of herbage in the pasture and compare the composition of each on the manured and unmanured plots.

This has been done at Rothamsted. A permanent grass plot of uniform composition was treated with various combinations of fertilizers. The herbage on the manured and unmanured portions was divided into (*a*) grasses; (*b*) legumes; (*c*) weeds; and representative samples of each group were analyzed for total ash content and phosphate content of the ash.

The following table summarizes the results:—

Table VII.—Showing Ash Content and Phosphate Content of the Grasses, Clovers, and Weeds in a Permanent Pasture on Manured and Unmanured Plots.

Nature of Herbage.	Total Mineral Matter.		Phosphoric Acid in the Ash.	
	Unmanured.	Manured with Phosphates.	Unmanured.	Manured with Phosphates.
	%	%	%	%
Gramineous (grasses) ..	6·40	6·86	4·79	9·67
Leguminous (clovers and trefoils)	8·07	7·79	4·81	8·59
Miscellaneous (weeds) ..	9·24	10·27	3·96	8·02
Mean	8·24	8·31	4·52	8·76

The table shows that the application of phosphates does not appreciably affect the average ash content of the mixed herbage, but that it does materially alter the proportion of phosphoric acid in the ash.

The phosphate content of the ash of grasses and weeds is more than doubled by the liberal application of water-soluble phosphate. The phosphate content of the ash of leguminoseae is increased by 80 per cent. The average phosphate content of the mixed herbage on the manured plot is 94 per cent. higher than that of the unmanured plot.

Wherever phosphoric acid was applied artificially there was a substantial increase in the phosphate content of the herbage.

From these experiments it is clear that the application of liberal dressings of water-soluble phosphates to the soil brings about a marked increase in the phosphate content of grasses, clovers, or weeds grown on that soil.

Exhaustive investigations at Rothamsted have shown that there is a close relationship between the ultimate chemical composition of the mixed herbage and the supplies at command within the soil. Further, these supplies, to a great extent, determined the type of plants encouraged and the character of their development, and the influence of these induced factors is clearly traceable in the chemical composition of the mixed herbage grown on the soil.

We may, therefore, assume that the application of soluble phosphates to Victorian soils normally deficient in this ingredient, will result in the following advantages:—

(1) One limiting soil factor controlling the vigorous growth of grass will be removed, and this will enable heavier crops of grass to be grown on the same rainfall.

(2) The soluble phosphate added to the soil will produce herbage with a much higher content of phosphoric acid.

(3) The grass thus produced will be better suited to produce vigorous healthy stock than grass from unmanured land. Being richer in phosphates, the grass on the manured land will be especially valuable for ewes in lamb, for dairy cattle, and for young growing stock.

Effect of Phosphates on Crop Growth.

1.—*Phosphates Promote Root Development.*

Lawes showed that the application of superphosphate led to the development of the lateral and fibrous roots of the plant. Watt showed that the application of soluble phosphates to a wheat crop encouraged deep-rooting habits.

Phosphates are particularly valuable wherever greater root-development is required than the soil conditions normally bring about. They are therefore of special value on clay soils, where roots do not naturally form well, and for shallow-rooted crops with a short period of growth, e.g., barley.

As the application of soluble phosphates encourage deep-root development, they are beneficial wherever drought conditions are likely to prevail. Hall has suggested that the marked effect of superphosphate

on wheat in the dry regions of Australia may be due to the fact that phosphates induce the young roots to grow rapidly into the moister layers of soil beneath the surface.

2.—*Phosphates Required for Early Development of the Plant.*

The movements of phosphoric acid from one part of the plant to another are remarkable. Phosphoric acid is the most mobile of the inorganic constituents of the plant. Arendt found phosphoric acid in the oat plant continually passing from the lower parts of the plant to the upper parts, especially after flowering.

The upper leaves and stem gave up more than 80 per cent. of the phosphoric acid they had accumulated and sent it into the ears.

Voelcker points out that the seeds of plants contain much phosphoric acid, whilst the soil usually contains very little. By putting phosphates in reach of the young plant we simply act upon a hint which has been "given by Nature in the care she takes to provide young plants in their earliest periods of existence with a constituent which possesses such a remarkable effect in pushing the young plant."

There is present in the protoplasm of the vegetable cell, and especially in the nucleus, an albuminoid substance called nuclein, which contains several per cent. of phosphorus, taken either from the phosphates in the original seed or from the phosphates in the soil. Phosphates are required for cell-division, and therefore for the vigorous growth of the plant. Thus, Lawes found that fat and albumen accumulated in the absence of phosphates, but that as soon as a trace of potassium phosphate was added, energetic cell-division took place.

Phosphates are also required for the transformation of the starch, formed as a result of photosynthesis, into sugars. Thus, Reed showed that starch was formed in the absence of phosphorus, but that it did not change to sugars.

We are therefore justified in assuming that, as Nature is so very careful in furnishing the embryo with an abundance of phosphates stored up in the seed, and since phosphates are so essential for energetic cell-division and for the transformation of starch into sugar, the presence of soluble phosphates in the soil during the early stages of the young crop is essential to vigorous growth and active development of the crop in its early stages.

3.—*Phosphates Hasten the Maturity of the Crop.*

Phosphates promote the early maturity of the crop. This may be seen in a striking manner on the Permanent Fertilizer plots at the State Farms. The plots liberally dressed with soluble phosphates turn colour from ten to twelve days before the unmanured plots. In dry seasons this earliness of maturity is of decided advantage to the crop.

The beet-grower often takes advantage of this characteristic of superphosphate. Since ripe beets contain more sugar than unripe beets, one consequence of early maturity is that the sugar manufacturer can obtain a highly saccharine juice at an earlier stage from fertilized beets. In the beet areas of Europe it has been customary to apply heavy dressings of phosphates to those fields from which the crop is to be harvested early.

The saying amongst beet-growers that "phosphates make sugar" is explained by the earlier ripening habit of the fertilized beets.

4.—*Phosphates Increase the Phosphate Content of Grass.*

It has been demonstrated above that one marked result of the application of soluble phosphates to grass land is that it greatly increases the phosphate content of the herbage. At Rothamsted it was shown that the phosphate content of the herbage was nearly doubled where liberal dressings of phosphate were applied. As our soils and our natural herbage are notably deficient in phosphates, this is a fact of fundamental importance.

5.—*Phosphates Economize Water Supply of the Soil.*

One important effect of soluble phosphates is to materially lower the Transpiration Ratio. This has been demonstrated by the writer, who showed that with wheat the Transpiration Ratio on unmanured controls was 377 for dry matter and 1,355 for grain. Where a normal dressing of nitrogen, phosphoric acid, and potash was applied the Transpiration Ratios were reduced to 292 for dry matter and 1,216 for grain. With excess dressings of the same plant nutrients the Transpiration Ratios were reduced to 270 and 871 for dry matter and grain respectively. In other words, the unmanured controls gave a 29 per cent. higher water requirement than the normal dressing and 39.6 per cent. higher water requirement than the heavy dressing.*

Fertilizers applied to soils either naturally poor or deficient in any nutrient not only greatly stimulated the yield, but appreciably lowered the water requirement both for dry matter and grain.

The addition of liberal dressings of soluble phosphates to a crop already well supplied with available nitrogen (as in well-worked fallows) not only increases the vigour and size of the crop, but lowers the Transpiration Ratio and brings about a more effective use of the limited supplies of soil moisture. This is a matter of vital importance in a region of limited rainfall.

6.—*Phosphates Increase the Bulk, Succulence, and Palatability of Herbage on Grass Land.*

This has been abundantly demonstrated by the results of the various experimental plots described above. These experiments have shown that the bulk of herbage has in many cases been more than doubled by the application of phosphates, that the proportion of clovers and trefoils has been greatly increased, and that the palatability and nutritive value of the pasture has been increased. Stock have shown a decided preference for the top-dressed grass, and chemical analyses of the herbage from top-dressed land showed it to be markedly superior to that of the non-fertilized area.

Fertilizers Used for Top-dressing Pastures.

Considerable stress has been laid on the importance of phosphates, because it has been shown experimentally that soluble phosphates may

* Cf. Water Requirements of Farm Crops. A. E. V. Richardson, Department of Agriculture, Victoria.

be applied with profit and advantage over the whole of the heavier rainfall country of Victoria. In localities with a heavy spring rainfall nitrates may be found advantageous as a supplementary dressing to phosphates, and on certain soils, e.g., peaty and sandy soils, even potash salts may be found necessary.

Lime, either in the form of carbonate, e.g., ground limestone or slaked lime (agricultural lime), may be required in regions of heavy rainfall and where the soil has developed an acid reaction.

Gypsum may be found useful on soils overlying stiff subsoils, but in these cases the improvement will be due to an amelioration of the texture of the subsoil.

Phosphatic Fertilizers.

Phosphatic fertilizers may be applied in three forms—

(*a*) Water soluble phosphate—e.g., superphosphate.
(*b*) Citrate soluble phosphate—e.g., basic phosphate.
(*c*) Insoluble phosphate—e.g., bone dust, rock phosphate.

Superphosphate is the most effective of the phosphatic fertilizers for top-dressing. The Department of Agriculture has tried superphosphate, basic phosphate, rock phosphate, and basic slag in top-dressing tests, but in all cases superphosphate has given the best results. The phosphoric acid in this fertilizer is almost wholly soluble in water and its action on pastures is immediate. It supplies phosphoric acid in a form in which it can be immediately used by the crop, and the effect of its application is noticeable in the increased vigour and growth of the young grass. It is known that superphosphate undergoes gradual reversion when applied to the soil—i.e., it gradually changes from water soluble form to a less soluble form. This being so, one might naturally ask wherein lies the superiority of superphosphate and why should he bother to convert rock phosphate into a water soluble form if the phosphate in the superphosphate begins to revert when it is applied to the soil. The probable explanation is that the phosphate in superphosphate, immediately it is applied to moist soil, becomes dissolved in the soil water and assumes a condition infinitely more minute than could ever be obtained by any process of mechanical grinding. In this fine state of division it becomes intimately diffused through the surface layer of soil and becomes gradually reverted on the colloidal or other fine particles of the soil. This extreme state of subdivision, combined with its intimate diffusion through the soil, makes it superior in its action to citrate-soluble or citrate-insoluble phosphate. Wherever the minute root hairs go in search of phosphate in the soil treated with superphosphate small quantities of very finely divided phosphate in a more or less assimilable form are to be found coating the finer soil particles.

Superphosphate has demonstrated its efficacy on pasture lands through a strip of country extending from Portland to Bairnsdale and from Tallangatta to Goroke. Throughout the wheat belt no fertilizer has given such satisfactory results as superphosphate.

Basic Phosphate and Basic Slag.

While the phosphoric acid in these fertilizers is not as soluble as that in superphosphate, it is far more soluble than the phosphoric acid in

bones and mineral phosphates. These two phosphates contain a certain amount of free lime, and in sour soils, and in regions of heavy rainfall, they may be useful in correcting soil acidity and furnishing phosphate in a reasonably soluble form. The phosphate is not soluble in water but dissolves in weak acids and in water containing carbonic acid, and therefore gradually comes into solution in the soil. The finer the basic slag is ground the more readily does the phosphate become available.

Basic slag has given remarkable results in clay grass-lands of Europe, its action being to encourage the growth of white clover in the pasture, which so increases the nitrogenous organic matter of the soil that greater growth of grass becomes possible. These fertilizers are most effective on heavy clays and sour soils deficient in lime.

Ground Rock Phosphate.

Ground rock phosphate applied in the form of a fine powder has been used in parts of the United States. Beneficial results have been obtained on sour land and on peaty soils, especially when the material was very finely ground.

Nitrogenous Fertilizers.

Nitrogenous manures are not usually profitable in Victoria. In Europe, however, they are very important. The limiting soil factor for crop growth in Britain is usually the amount of available nitrogen in the soil, but in Australia the quantity of available phosphate sets the limit for crop growth.

Under European conditions, the heavy rainfall causes extensive losses of nitrates from the soil by leaching, the intensive system of cropping in vogue leads to rapid depletion of nitrates, and nitrification does not usually proceed actively on account of the relatively low soil temperatures.

In Australia the losses by leaching are slight, the soils have not been under cultivation for a great length of time, the system of cropping is extensive, and nitrification has been shown to proceed most actively in our soils. For these reasons, the application of nitrogenous manures is usually unprofitable in the areas of lighter rainfall. In the high rainfall areas and the hill country, a limited call for nitrogenous manures exists.

Nitrate of soda and sulphate of ammonia are likely to be most useful fertilizers to supply this need. Both manures are very soluble in water. The relative merits (apart from price per unit of nitrogen) of nitrate of soda and sulphate of ammonia depend largely on the nature of the season during which they are used. In wet seasons the sulphate of ammonia is rather more favorable than nitrate of soda, and is less likely to be lost from the soil; but in normal seasons nitrate of soda is probably the more valuable fertilizer.

Potassic fertilizers are not likely to be required, except on peaty soils and on light sandy soils. Loamy soils and clay soils usually contain adequate amounts of potash.

Lime and Ground Limestone.

These substances may be useful in heavy rainfall country on "sour" soils. They supply the soil with a base which neutralizes any acidity

or sourness of the soil, and they markedly improve the physical condition of the soil. The change in the physical condition is brought about by carbonate of lime going into solution in soil water containing carbonic acid gas in solution. The bicarbonate of lime so formed causes the flocculation of the very fine particles of colloidal clay, and the soil is thus made more open and porous.

It is obvious that the action of lime, ground limestone, or chalk on the texture of the soil must necessarily be slow, because the ameliorating effect of these substances begins when they are dissolved by the carbonated water in the soil. These substances are usually applied to improve the soil texture, and correct sourness or acidity in the soil, rather than to supply the soil with plant food. They are, therefore, used in relatively heavy dressings, e.g., from 10 cwt. to 20 cwt. per acre; and infrequently, i.e., every four or five years. Over a considerable area of Victoria, lime or limestone does not give a material response. On country with a heavy rainfall, e.g., over 30 inches, considerable quantities of carbonate of lime are leached from the soils, which are naturally low in lime content, and in these areas the application of ground limestone or agricultural lime will be beneficial.

Time of Application of Artificial Manures.

The time at which the manures are applied depends upon the type of fertilizer and the climatic conditions of the locality.

Phosphates are best applied when growth of grass commences. For southern Australia, this corresponds with the Autumn. If applied in the autumn, root development is favoured, early growth is stimulated, and the grass makes good headway before the cold of winter. It is held by some that there is a danger of losing a good deal of the phosphatic fertilizers, especially a water-soluble phosphate like superphosphate by spreading it in autumn and allowing it to receive the full force of the heavy winter rains. There is little in this theory, and need be no anxiety regarding the fate of the soluble phosphate.

Water-soluble phosphate is rapidly fixed by the finely divided colloidal matter of the soil within a few inches of the surface.

This fixation of phosphates is of great practical importance. Carbonate of lime, compounds of iron and alumina, are able to arrest any water-soluble phosphate that may be applied to the soil. Though nitrates are regularly found in drainage waters, especially from soils heavily dressed with nitrates or ammonium salts, phosphoric acid is rarely found in the drainage waters.

Voelcker filtered barnyard liquor through loams of various kinds, and found that practically all the phosphoric acid in the liquid was speedily fixed by a moderate quantity of soil, even when the latter was poor in lime.

Dyer was able to show by analyses of the soil from the manured and unmanured plots at Rothamsted, that the heavy dressings of superphosphates added annually during a period of 70 years did not penetrate the subsoil. He found that the difference between the phosphate content in the soil of the two sets of plots was approximately equal to the total quantity of phosphoric acid which had been applied to the soil during

the 70 years, minus the difference in the calculated quantity removed by the overhead portion of the crops from the two plots.

Soluble phosphates are easily fixed by the soil, and prevented from being washed into the subsoil or into the drainage waters. Superphosphate may therefore be applied early in autumn without risk of any loss. As it gives such a decided stimulus to root-growth, and plays such an important part in the nutrition of the crop in the early stages, it might well be applied with the first autumn rains.

Potash, like phosphoric acid, is firmly fixed by the soil. Potassic manures may therefore be applied with safety early in autumn.

On the other hand, the soil is unable to hold nitrates. These are readily washed out of the soil by heavy rains. Fertilizers, such as nitrate of soda, are therefore best applied in early spring as a top dressing. Ammonia is more or less firmly held by the soil. In wet localities, and in wet seasons, sulphate of ammonia is to be preferred to nitrate of soda. Lime and ground limestone are usually applied as a soil ameliorant. They act by becoming dissolved in carbonated water to form bi-carbonate of lime, which speedily flocculates the fine colloidal clay particles.

The efficacy of the carbonate of lime depends on the rate at which it dissolves in carbonated water. Hence it should be applied early in autumn, so that the full solvent action of the winter rains may be obtained.

Rate and Frequency of Application.

The rate at which fertilizers may be applied to grass lands depends largely on the amount of rainfall and the nature of the soil. In regions of heavy rainfall, where heavier and more continuous production of grass is possible, liberal dressings should be used. Similarly, while poor land will show a greater relative response to fertilizers than rich land, the rich land can better bear the cost of heavier applications than light land.

Much work is necessary to determine the quantity of various fertilizers required for grass land in the different climatic regions of the State. It may be said, however, that the recent experiments of the Department and of the Chamber of Agriculture show that at least 1 cwt. of superphosphate should be applied, and that in many cases an initial application of 2 cwt. is advisable. The actual amount should be determined on each farm by sowing a few trial plots. Where lime or ground limestone is required, it should be applied at the rate of from 10 to 20 cwt. per acre. One application usually lasts for several years.

With regard to the frequency of application, it has been shown that the effects of one application of phosphate persists for at least four years, but the greatest improvement is observed the same year as the phosphate is applied.

After the initial application of superphosphate, dressings of, say, 1 cwt. per acre may be repeated every two or three years. This is a matter that each farmer must work out for himself on a strict financial basis. There is no reason why the grass crops should not be treated in the same way as a wheat or hay crop, i.e., given a dressing each year of an amount of phosphate at least equal to that removed by a normal crop.

Nitrates or sulphate of ammonia are usually sown at a lesser rate than phosphates. From 40 to 60 lb. of these fertilizers per acre usually suffices, but they should be used as a supplement to phosphates; not as a substitute for them. They are best applied as a top-dressing in early spring in regions of heavy rainfall. They do not persist in the soil like phosphates, so that wherever nitrogen is found to be lacking annual dressings of these fertilizers will be necessary.

Method of Application.

The fertilizers may be applied with a seed-drill, or a fertilizer distributor, or they may be broadcasted. For grass lands, the fertilizer distributor is a convenient method of applying the fertilizer. It covers a strip of from 9 to 10 feet wide and requires but one horse. It will sow small quantities, e.g., from 1 to 2 cwt., and if required, larger quantities up to 1 to 2 tons. It is, therefore, useful both for spreading artificial manures and also for spreading lime, gypsum, or ground limestone.

The harrowing of the pasture before the application of the fertilizer is advisable.

Application of Results to Victoria.

The results of the top-dressing tests recorded above have a wide application to Victoria. Most of the lands in the heavier rainfall country are deficient in available phosphates. They have long been settled and heavily stocked, and the drain on the mineral nutrients partly by leaching, but mainly by removal of nutrients through the annual crops of wool, lambs, and fat stock has been considerable. No wheat-grower would now think of seeding his crop without soluble phosphate, nor should the grass-grower expect to raise good nutritious grass without the application of phosphates. Our soils are low in available phosphate, and they have been made poorer by several generations of improvident stock husbandry.

The welfare of Victoria depends largely on the number of stock that can be kept in the good rainfall country. The number can be greatly increased—certainly doubled, and possibly trebled—by concentrating attention on the development and improvement of the grass lands of the State. By the adoption of rational cultural practices, the use of suitable grasses and clovers, and the application of soluble phosphates, the stock-carrying capacity of his pastures may be greatly augmented, and the health of the stock much improved.

We need to recognize the vast importance of the grass crop to the State, and to treat the grass in a rational manner. The results obtained in the experiments conducted by the Department of Agriculture and the Agricultural Societies suggest a means whereby every farmer may bring about a material improvement in the carrying capacity of his farm.

Through the use of soluble phosphates, combined with improved cultural methods, a remarkable transformation has been effected in the wheat belt of Northern Victoria. With the aid of soluble phosphates, the use of suitable grasses and clovers, and the rational treatment of grass lands, an even more remarkable change may be effected in the

30,000,000 acres of pasture land in this State, which will result in a great increase in the numbers of stock carried, and a material improvement in the fertility of the soil.

Summary.

1. Australian grasses are noted for their grazing qualities and for their capacity to withstand great extremes of heat and drought. The native plants should be made to furnish the bulk of our pasturage in the drier areas. In the moister areas, introduced grasses and clovers should be freely used.

2. Nearly 4,000,000 acres of land are devoted to artificially-sown grasses in Australia. Victoria has 1,300,000 acres of sown grasses.

3. Cultivated pastures furnish feed at low cost, require very little labour when once established, and are essential in reclaiming certain types of land.

4. Grass lands deteriorate mainly by (1) over-stocking; (2) removal of mineral nutrients by leaching, and by losses through live stock.

5. The better types of native grasses are killed out by over-stocking, owing to their slow growth and non-seeding habits. Introduced plants of low grazing value readily supplant the native grasses.

6. A fruitful cause of deterioration is the removal of the mineral nutrients by the annual drafts of live stock products sold off the farm. It is estimated that during the past 60 years 360,000 tons of phosphoric acid, equivalent to 1,800,000 tons of superphosphate, have been removed from the grass lands of the State.

7. Grass lands may be improved in three ways—

(*a*) Sowing down with native or introduced grasses.
(*b*) The use of liberal dressings of fertilizer with root and cereal crops.
(*c*) By top dressing natural or sown pastures.

8. The seeding of native grasses is expensive on account of scarcity and high price of seed, and the low vitality of seed. The sowing down of introduced grasses and clovers is recommended for the moister districts and the highlands. The type and mixture recommended depends on the character and amount of rainfall, and the fertility of the soil.

9. The improvement of grass through the liberal fertilization of cereals and root crops may be practised over the whole arable area of the State. It is specially valuable in the wheat areas. The liberal use of fertilizers gives a full crop and a good residuum for stimulating the grass on the stubbles.

10. Top dressing is a sure means of improving grass land. The response is most marked in regions of heavy rainfall, where there is more leaching, and on those lands that have been longer settled, and those which have undergone heavier and more continuous grazing.

11. Experimental work has clearly demonstrated that for Victoria soluble phosphates are the most valuable fertilizers for top dressing.

12. The stock-carrying capacity of land at Rutherglen has been doubled by the application of moderate quantities of soluble phosphates.

13. At Hamilton and Glenthompson, the bulk of grass on plots treated with superphosphate was treble that of the unmanured plot, and the effects of the phosphate were noticeable at least three years after its application.

14. A close relationship exists between the chemical composition of the soil and the composition of the mixed herbage growing on the soil. Soils deficient in phosphates produce grass with a low phosphate content. Phosphate-starved grass produces phosphate-starved stock. The application of liberal dressings of phosphate to the soil results in a great increase in the phosphate content of the grass, and an improvement in the health and vigour of stock.

15. Phosphates promote root-development and early growth, and hasten maturity. They lower the transpiration ratio, and thus lead to economical use of the water supply of the soil. They increase the bulk, succulence, nutritive value, and palatability of the pastures. The addition of soluble phosphates removes the important limiting soil factor for heavy production.

16. Superphosphate is the most profitable form in which the deficient phosphate supply may be made good. For the greater portion of Victoria, it is the only fertilizer required at present to stimulate pasture growth. Basic phosphate and basic slag stand next in value to superphosphate, and may be useful on sour lands and in peaty soils.

17. There is a limited call for nitrogenous fertilizers, but only in regions of heavy rainfall, where leaching is excessive, and where nitrification proceeds slowly.

18. Carbonate of lime and agricultural lime may be required on heavy rainfall country to correct sourness in the soil and improve the texture of stiff clays.

19. Phosphates should be applied with the first autumn rains. They are not likely to be lost from the soil even by the heaviest rains. As soluble nitrogenous fertilizers are readily washed out of the soil, they should be applied as a top dressing in early spring. Lime is best applied early in autumn.

20. Grass is Australia's greatest crop, and a study of the principles underlying its successful production is of great national importance.

WHEAT AND ITS CULTIVATION.

(Continued from page 157.)

By A. E. V. Richardson, M.A., D.Sc., Agricultural Superintendent.

METHODS OF CULTIVATION.

The wheat belt of the Commonwealth is located in a region of moderate to light rainfall. Rainfall is the most important limiting factor over a considerable proportion of the area. Conservation of soil moisture is therefore of fundamental importance in this region, and systems of cultivation must be practised which will conserve as much soil moisture as possible.

More, however, is required than this. No system can be permanently effective unless it provides for the maintenance of the fertility of the soil. The aim of the cultural operations should therefore be (1) to conserve soil moisture; (2) to maintain the fertility of the soil; and these two points require consideration when discussing any given system of cultivation for wheat-growing under Australian conditions.

That bare fallowing is so largely practised in the drier areas shows that the farmer appreciates the importance of moisture conservation, and the fact that there are many wheat lands in this young country which practical farmers and the press frequently describe as "worn out" shows that the importance of maintaining soil fertility is often overlooked.

PROGRESS OF AGRICULTURAL METHODS.

The progress of agriculture has been much the same in all countries. It develops by gradual and almost imperceptible stages from extensive to intensive culture. In the early stages of a new country, lands are cheap, capital and human labour comparatively scarce and dear. The virgin soils are comparatively fertile and will usually yield heavy crops for many years. To suit these circumstances large areas are sown under pioneer conditions. Large areas under crop and relatively small average returns per acre are the rule. As population increases the land values in the settled districts rise, and the margin of cultivation is gradually extended into newer and drier country; the large holdings gradually become subdivided, and an era of intensive culture in the more densely settled localities is gradually ushered in. In these localities the individual areas under crop are small, but the average yield is high, and the system of cultivation gradually changes from continuous cropping to a well-developed rotation system in which more and better directed labour is used.

If most of the inhabitants of a new country are engaged in agriculture, the supply of agricultural products will not usually fall below the home requirements. In the newer countries, the level of prices is generally lower than in older and more crowded countries, where the large consuming population tends to keep the price of agricultural commodities at a high level.

Extensive Wheat Culture on Hill River Estate, South Australia, in 1875.

Ploughing.

Seeding Operations.

Intensive farming involves more labour and expense than extensive farming, and consequently a larger capital is essential. As the level of prices for farm products cannot be so high in a new country, and as capital is not so abundant, it follows that farming will not be of such a high and intensive grade as in older countries.

The Hill River Estate, in South Australia, is a typical example of the extensive methods of cultivation practised in the pioneering days. In 1875 the estate was 60,000 acres in extent, and carried 50,000 sheep. The cultivated land was in large fields, one of which was 3 miles long, containing, in 1873, no less than 4,250 acres of wheat in one block. According to Harcus's *History of South Australia* (1876), the ploughing was performed, in 1874, by "Thirty four-horse teams drawing a double plough, and five single ploughs striking out. The seed, which was of several kinds, to ascertain the best, was sown the first week in June with six of Adamson's 22-ft. broadcast machines, sowing 40 acres a day each. The pickling used was bluestone, and an ingenious dipping apparatus was used by which a bag at a time could be done with great rapidity. The lands were ploughed in 1-chain widths, and harrowed by fifteen sets of six-leaved harrows, doing a land in two turns. The harrowing was done at the rate of 500 acres a day. As harvest approached 2-chain wide strips were cut by mowing machines, at intervals, cutting the wheat into 200-acre blocks, and then the strips were ploughed, for the prevention of fire. Thirty-seven strippers were used to take off the crop (1874). Three crops were taken off in succession, and then the land was laid down to pasture."

Four years later, there were 850 working horses fed under cover every day; the amount of land under crop was 11,000 acres per annum; and 65 strippers were used in taking it off.

THREE SYSTEMS OF CROPPING.

Wheat may be grown under three different systems of cropping:—

1. Continuous cropping with wheat.
2. Wheat alternated with bare fallow.
3. Wheat grown in rotation with cereals, pasture or forage crops.

(1.) Continuous Cropping.

Continuous cropping with wheat is often practised in newer countries.

Expedient and profitable though it may be, however, where pioneer conditions prevail, the sowing of wheat year after year on the same land is condemned both by theory and by practice.

While it may be said that continuous growing of wheat year after year is not good practice, the results from the Broadbalk field, at the Rothamsted Experiment Station, show that it is possible, but only by liberal manuring.

The highest yield was obtained on plot 8, viz., 36.6 bushels per acre, but to obtain this result heavy applications of nitrogenous, potassic, and phosphatic manures had to be applied each year. The average yield of the unmanured plot for this period was 12½ bushels.

While continuous cropping with wheat has been practised on these experimental plots at Rothamsted for over 70 years, it must not be

supposed that such practices could be followed with profit in the drier areas of this State. The rainfall at Rothamsted is 28½ inches, and the distribution throughout the year is fairly uniform.

The yield of wheat grown on land continuously cropped without fertilizer, and with an annual dressing of 1 cwt. per acre, has been determined at Werribee for the last eleven years.

The results are as follow:—

Table showing Average Yields for Eleven Years from Plots sown Continuously with Wheat, and from Plots on which Wheat was Alternated with Bare Fallow, State Research Farm, Werribee.

Plot.	Average Yield for 1912–23.	Yield for 1923.
1. Wheat sown continuously without manure	·5·4	1·5
2. Wheat sown continuously (1 cwt. super.)	9·0	2·5
3. Wheat after bare fallow (unmanured) ..	8·1	10·8
4. Wheat after bare fallow (1 cwt. super.)	15·5	27·0

Continuous cropping with wheat is practised in the pioneering stages of wheat-growing in the Mallee areas, mainly because of the necessity of eliminating the ubiquitous mallee shoots. Experience has shown that after a good "burn" on the rolled mallee, the most effective agent in ridding the land of these shoots is a series of good stubble burns.

The pioneer wheat-grower in the Mallee often takes four or five successive crops of wheat from the virgin soil, and burns the stubble each year in the hope of finally killing the shoots.

Once this pioneering period is over the wheat-grower is free to follow rotation systems which aim at conserving soil moisture without impairment of the fertility of the soil.

(2.) Wheat After Bare Fallow.

From continuous cropping to bare fallowing is a natural transition, especially in a relatively dry district. Continual cropping with the same crop encourages weeds to such an extent as to ultimately render a period of rest and cleaning absolutely necessary.

The marked advantages of this period of rest and cleaning must have appealed very strongly to the early pioneers. So far as bare fallowing is concerned, it is an indispensable preparation for a maximum crop in all districts where the rainfall is relatively low, because it enables the wheat crop to make the very utmost use of the limited rainfall.

Wherever the annual rainfall is below 20 inches, bare fallowing is necessary to obtain a profitable wheat crop.

The main advantages of fallowing for wheat are as follow:—

(*a*) It conserves soil moisture.

(*b*) It increases the available food supply of the soil.

(*c*) It distributes the farm work more evenly throughout the year.
(*d*) It ensures a clean, firm seed-bed for the wheat crop.
(*e*) It leads to heavy wheat yields.

As these matters are of fundamental importance for successful wheat culture in the drier areas, we may consider the principles involved in some detail.

(*a*) Conservation of Moisture.

Over the greater part of the wheat belt the rainfall during the growing period of the crop is below the optimum for heavy yields.

The heaviest wheat yields are usually obtained in Victoria when from 14 to 15 inches of rain are received throughout the growing period, April to October, and when a considerable proportion of this rainfall occurs in September and October. During October, the wheat crop is at its period of maximum transpiration, and the drain on the moisture supplies of the soil is very heavy. Hot, dry northerly winds are frequent at this period. These dessicating winds cause intense transpiration from the wheat crop, and as the supplies of soil moisture at this season of the year are approaching exhaustion, the crop often shows signs of wilting. Whenever this happens there is a material reduction in the wheat yield. When the rains in September and October are light, the hot winds in spring and early summer do much damage.

The fundamental principle underlying the practice of bare fallowing is that it conserves soil moisture—the limiting factor for successful agriculture in a semi-arid region—and it enables a considerable portion of the rainfall of one year to be conserved in the soil through the summer, and thus augments the supplies which fall subsequent to the sowing of the crop. It places at the disposal of the wheat crop the rainfall of two seasons.

The amount of moisture conserved in the soil by bare fallowing is shown by investigations made at the Rutherglen Experiment Farm and the Longerenong Agricultural College in a relatively dry season (the fallowing period of 1912). Fallowing was completed in August, and on 1st May in the following year the percentage of moisture in the first 4 feet at each centre is shown in the following table:—

Table showing Percentage of Moisture (in terms of Dry Soil) on Fallowed and Non-fallowed Land prior to Seeding (1st May), Rutherglen and Longerenong, Victoria.

Depth of Sample.	Rutherglen.			Longerenong.		
	Fallowed.	Non-Fallowed	Difference.	Fallowed.	Non-Fallowed	Difference.
0 – 12 inches ..	7·62	3·12	4·50	26·39	16·92	9·47
12 – 24 „ ..	16·37	10·52	5·85	28·75	20·26	8·49
24 – 36 „ ..	16·68	12·28	4·40	27·81	25·16	2·65
36 – 48 „ ..	21·26	19·68	1·58	28·65	32·07	3·42
Average content of first 4 feet ..	15·48	11·40	4·08	27·90	23·60	4·3

Thus at Rutherglen the fallowed land had 4.08 per cent. more moisture in the first 4 feet than the non-fallowed land alongside.

Assuming the weight of an acre-foot of dry soil to be 3,500,000 lbs., it follows that in the first 4 feet of the Rutherglen fallow there was 571,200 lbs. more water per acre in the fallowed land than in the non-fallowed portion, i.e., an amount equivalent to 2.5 inches of rain. Similarly at Longerenong 4.3 per cent. more moisture was conserved in the first 4 feet, i.e., an equivalent of 2.6 inches of rain.

During the preceding nine months—the period of fallowing—the rainfall at each centre was:—Rutherglen 6.59 inches, and Longerenong 9.01 inches. Comparing the extra water saved by fallowing with the rainfall during the fallowing period, it will be seen that at both stations the water conserved represented a considerable proportion of the rainfall.

(*b*) Bare Fallowing Increases the Supply of Available Plant Food.

The extra moisture conserved by the process of fallowing stimulates bacterial activity within the soil. This results in the formation of many valuable plant foods. Among these are nitrates.

The important process of nitrification of the organic matter proceeds very actively in a well worked fallow. Nitrification is caused by specific bacteria which act on the organic matter of the soil and convert it by three stages into nitrates.

In the presence of the air the organic matter is first converted by a group of bacteria into water, carbonic acid and ammonia, just as it would be if it were burnt. This is the preliminary stage of the process of nitrification.

Warington was the first to demonstrate the fact that there were two stages in the process.

1. The formation of nitrite
2. The formation of nitrate.

Winogradsky was able to isolate two groups of bacteria capable of transforming the ammonia into nitrates:—

1. (*a*) *Nitrosomonas europeae*—peculiar to European soils.
   (*b*) *Nitrococcus*—peculiar to the soils of Australia and America.
2. One type of organism converting the nitrite into nitrate—Nitrobacter.

Many workers have determined the conditions of life favorable for these nitrifying bacteria. As a result of their combined work, we now know that the following soil conditions are necessary:—(*a*) A favorable temperature; (*b*) sufficient supplies of soil moisture; (*c*) sufficiency of air in the soil; (*d*) presence of a base; (e.g., carbonate of lime), to combine with the nitric acid formed.

Well-worked bare fallows comply with the conditions required for active nitrification.

Nitrification is most active at 98 degrees F., and at this temperature it is ten times as active as at 57 degrees F. Soil temperatures

during the summer months in northern Victoria range from 80 degrees to 90 degrees F.

The extra moisture conserved by fallowing, and the frequent aeration of the soil which follows the cultivation of the fallows, ensure an adequacy of moisture and air in the soil. The wheat soils of Victoria are neutral to slightly alkaline in reaction, and are not wanting in carbonate of lime. Hence, under our conditions nitrification should be very active in well-worked fallows.

The amount of nitrate nitrogen formed during the fallowing period has been determined at Longerenong. The amount of nitrate nitrogen formed in fallowed and non-fallowed soil to a depth of 5 feet on 1st May was as follows:—

Fallowed land, 91.9 lbs. nitrate nitrogen per acre.
Non-fallowed land, 21.0 lbs. nitrate nitrogen per acre.

As a 15-bushel wheat crop removes in its grain and straw 21 lbs. of nitrogen per acre, it will be observed that in fallowed land there was sufficient nitrogen present to provide for the needs of a 60-bushel crop, while on the non-fallowed portion the nitrate present would just satisfy the requirements of a 15-bushel wheat crop.

It is obvious then that by bare fallowing the available nitrate supply for the crop can be greatly increased. In addition to the increase in nitrates, there can be little doubt that other important plant foods, particularly phosphates and potash, are converted from unavailable to available forms.

(*c*) Bare Fallowing Distributes the Farm Work Evenly throughout the Year.

The team and labour distribution is more evenly spread throughout the year when bare fallowing is a regular part of the farm routine. Summer fallowing may be begun immediately after harvest, and winter fallowing after seeding.

The great economic advantage of bare fallowing for wheat is that it enables the wheat-grower to have large areas of land in the best possible state of tilth to receive the seed as soon as the weather conditions are favorable for seeding. This is a matter of considerable importance in the drier districts of the State, where the normal seeding season is so restricted.

When the conditions are favorable for seeding the farmer should concentrate his teams and energy, not on the ploughs, but upon the drills. If ploughing is delayed till autumn, the seeding will be delayed, and there is the risk that the seed will be sown on an imperfectly prepared seed-bed.

(*d*) Bare Fallowing Establishes a Clean, Consolidated Seed-bed.

Bare fallowing cleans the land of weeds, and permits the seed to be sown on a clean seed-bed. It also permits the formation of a firm, consolidated seed-bed. The experienced wheat-grower knows the value of a firm, seed-bed for the wheat crop. The consolidation of the soil and the establishment of a layer of finely-divided, firm soil below the surface mulch of coarser material is not effected in a week or a month. Time is a factor in the process. The consolidation is effected by the

packing action of the rain, and the establishment of a layer of finely-divided soil particles below the mulch is effected by frequent cultivation when the moisture content of the soil is favorable for such tillage.

Limitations of Bare Fallow.

Unnecessary and Unprofitable in Humid Localities.

Bare fallowing is a necessity in a dry district. Its main aim is the conservation of moisture. In a region of heavy rainfall it is not necessary for moisture conservation, because the normal rainfall in the growing period is sufficient for the demands of the crop.

It may be said that in localities with a rainfall of under 20 inches per annum, with a normal distribution of 70 per cent. during the growing period (April-October), bare fallowing is a necessity for successful cropping each year. In regions of higher rainfall than 20 inches moisture conservation is less important, and bare fallowing may be replaced by fodder crops or fallow crops.

The most serious drawback to bare fallowing is that only one crop may be grown in two years, so that the wheat crop must be debited with two years' rental value of the land.

Where land values are relatively low, and the climate relatively dry, this is not a serious matter, for the difference between the crop grown on fallow and that grown on stubble land may be so great as to make the two years' rental, which the fallow crop bears, an item of little consequence. On the other hand, in districts where land values are high, the loss of a crop may be a matter of importance. High land values are restricted to the relatively humid areas of the State, where considerations of moisture conservation are of secondary importance.

Where the annual rainfall is well over 20 inches, and land values are high, bare fallowing should be substituted by a skilled system of rotation and catch-cropping, if the soil resources are to be fully utilized.

The nitrates formed during the process of fallowing are extremely soluble in water, and the soil has little power to hold them. Unless the bare fallow is supplemented by a fallow crop or by a catch-crop, the valuable nitrates formed in the soil may be leached out.

Bare Fallowing Leads to Depletion of Organic Matter.

A continual alteration of wheat and bare fallow must ultimately lead to the depletion of the organic content of the soil, especially in cases where the wheat stubbles are regularly burned. The organic matter is slowly lost by oxidation in well-tilled fallows, and in burning the stubbles, 95 per cent. of the total dry matter in the straw is lost in gaseous form.

Organic matter is the most valuable constituent of the soil. Any serious lessening of the organic content of the soil must inevitably result in a lowering of the crop-producing power of the soil.

Organic matter has an important effect on the soil. It increases its water-holding capacity and improves its texture. It supplies nitrogen necessary for the nutrition of the crop, and it promotes vigorous bacterial activity in the soil. Alternate bare fallowing and wheat-cropping without a period of rest or pasturage will slowly deplete the soil of its organic matter.

Local data are wanting as to the rate at which organic matter is lost by slow oxidation in the process of fallowing, but there can be no doubt that in hot, dry districts the loss is considerable.

It is a matter of common observation that many of our old wheat lands are more difficult to plough and reduce to a satisfactory tilth than virgin land of the same character in the same locality. This is mainly due to the reduction of the organic content of the soil.

There are three ways of counteracting this reduction in the organic content of the soil:—(*a*) The application of stable manure ; (*b*) pasturing or resting the soil; (*c*) the growing of fodder crops for grazing down with sheep.

The application of farmyard manure for restoring the organic matter is not practicable for the wheat areas. The average wheat farm is too large to be appreciably affected by the total farmyard manures produced on the wheat farm. Most growers rest or pasture the land after the removal of the wheat crop, and many, especially in the more favoured districts, grow fodder crops, oats, rape, &c., for feeding down with sheep.

(3.) Wheat Grown in Rotation with Pasture, Fallow, or Crops.

Continuous cropping with the same crop and the biennial system of cropping and bare fallowing have been shown to fall short of a permanent system of agriculture.

Sheep have acquired an important place on most wheat farms, and it is now generally recognised that the association of sheep farming with wheat-growing ensures economical and profitable working.

The association of sheep with wheat-growing presents many advantages. The sheep utilize roughage on the farm which could not otherwise be used. They do well on the stubbles of the wheat crop, utilize the herbage on the lay land, and keep the fallows clean and well consolidated. They work in well with wheat because the maximum demands of a flock of ewes with their lambs are made when there is a flush of spring herbage, and the lambs are usually marketed before the grass begins to dry off. They utilize the herbage on the fallows, and assist in bringing about that consolidation of the seed-bed so necessary for a successful wheat crop. On light Mallee country this is a factor of importance. They assist in maintaining the fertility of the farm for much of the phosphoric acid, potash and nitrogen found in the herbage is returned to the soil in the droppings of the sheep. This is especially true of a flock of mature animals. They contribute substantially to the profits of the farm on account of the relatively small amount of labour and attention required by the farm flock in comparison with the actual money returns. The high prices ruling for both mutton and wool, the rapid development of the frozen meat trade, and the rise of country cool stores make it essential for a wheat-grower to keep sheep in order to extract the maximum net profit from his farm.

To maintain sheep continuously on a wheat farm, a portion of the area should be periodically reserved for pasture, and some system of crop rotation becomes necessary. The most important advantages

accruing from a rational system of crop rotation is that it leads to the best possible utilization of the resources of the soil, and makes for maximum crops. Different crops vary very widely in the manner in which, and the depth at which, they obtain their nutriment from the soil. Some obtain it from relatively shallow depths, whilst others are deep rooted, and by alternating such crops, the store of fertility is more evenly used up. A well-planned system of rotation leads to a better and more economical distribution of labour throughout the farm year, and thus enables a farmer to offer permanent, instead of casual, employment to farm hands. Moreover, it aids in preventing the ravages of disease, for crops susceptible to the attack of specific fungoid pests are less liable to be attacked when grown in rotation with other crops. An illustration of this may be seen with regard to "take all" in wheat. This fungoid pest attacks wheat, but oats are immune from the disease. By growing wheat in regular rotation with oats and bare fallow, the pest may be controlled. It enables land to be cleaned without the employment of special labour, for where one kind of crop is grown repeatedly, the weeds favoured by that crop cannot be kept in check. Finally, it provides a means whereby the fertility of the soil may, by rational treatment, be maintained, and even increased.

A regular system of rotation—by which is meant that different kinds of crops are made to succeed one another on the same ground in regular order—is a feature of the advanced forms of agriculture practised in the older countries of the world. We must not fall into the error of assuming that because certain rotations are found profitable in the densely populated countries of Europe, that they would be equally applicable in a new country like Australia, with a relatively sparse population.

The most advanced and profitable rotation for us will be that which is best adapted to the exigencies of our peculiar climatic and economic conditions. What are the conditions obtaining in the wheat areas? The climate is such that the greater part of the rain falls during the winter months. The spring and summer rains are irregular, and rarely copious. Hence, in the wheat areas proper, the growing of summer crops is more or less risky and uncertain, and for securing suitable crops for rotating with wheat we are driven back to the use of winter-growing forages or cereals.

Among the economic considerations, the labour problem is of great importance. To break away from an extensive system of culture and adopt intensive methods is to change from a system in which a minimum of labour is required to one necessitating the employment of a maximum of labour. To rear and feed a large number of live stock, to rotate and diversify crops, and to follow the hundred-and-one practices of the intensive farmer, imply the expenditure of additional capital and labour. In densely crowded countries, the latter factor of production is usually abundant. In a sparsely populated country, in which immigration cannot keep pace with local requirements, trained farm labour is at a premium. The increasing cost of, and difficulty in securing efficient farm labour are causing many farmers to lessen the area devoted to cultivation, and increase the area under grazing.

mining the method of cultivation adopted, for the smaller the holdings, the more intense must be the methods of cultivation.

The size of the holding is obviously an important factor in deter-

The values of farming land in the wheat areas have an important bearing on the methods of cultivation followed. Throughout the wheat areas, land values have considerably appreciated during the past decade, and this appreciation has been largely due to the increased productive power of the soil, brought about by improvements in cultivation. It may be contended that the present prices represent high-water mark, and that values are not likely to ascend beyond the present limits. This belief, however, would imply that we have reached such a high stage of development in wheat growing that further improvements are impossible. It implies that the system of agriculture practised at the present time, which, by the way, is quite normal in a country occupied by a mere handful of people, must be a permanent characteristic of a country with an ever-expanding population. High though the land values may be, it is certain that they must ultimately increase with the pressure of population, and those who find themselves unable to make satisfactory interest on the enhanced capital values will gradually make way for those who can.

Let us now consider the rotations practised in the wheat belt in Victoria.

In the mallee areas the most usual rotation is wheat, pasture, bare fallow. Experience has shown that this is a very suitable rotation to follow in the drier areas.

Under this system the average farm of 640 acres would have, say, 40 acres reserved for horse paddocks, buildings, roads, &c., and the balance would be treated as follows:—200 acres would be cropped each year, 200 acres would be devoted to pasture, and 200 acres would be bare fallowed. Since but one crop is taken off the land in three years, and the crop is followed by a year of pasture, the system is not exhausting. The preparatory year of bare fallowing assures the success of the wheat crop. Whether the soil will accumulate sufficient organic matter during the year it is lying in pasture to cover the losses through bare fallowing has not been determined. Under this system of rotation a small flock of sheep is maintained on the farm. The actual number will vary with the quality of the land, ranging from 150 with average Mallee land to 300 on the heavier rainfall country.

In specially favorable seasons more sheep may be maintained, in which case store wethers for fattening may be purchased. Should a dry spell occur, the number of sheep may have to be reduced unless suitable fodder has been conserved as an insurance against such dry spells.

This system of crop rotation does not require much labour, and is well adapted to the lighter rainfall areas where fallowing is a necessary preliminary for wheat, where land is cheap enough to be used for cropping once in three years, and where the farms are sufficiently large to give a minimum area of 200 acres under crop, and permit of 200 acres being fallowed.

(To be continued.)

REGISTRATION OF STALLIONS,

Fourth Annual Report under the Horse Breeding Act 1919.

By W. A. N. Robertson, B.V.Sc., Chief Veterinary Inspector.

The dissatisfaction with some of the provisions of the Horse Breeding Act, which was referred to in the last report, was revived during last season, and eventually led to the formation of a Committee to inquire into and suggest amendments of the Act. It is to be regretted that, during the deliberations of this Committee, no official of the Department was present to assist the inquiry and remove some of the existent misconceptions.

An opinion which is frequently heard is that the dearth of good stallions in Victoria is due to the provisions of the Act, and that all the good horses have gone to New South Wales. In this connexion, it is interesting to study a report of the New South Wales branch of the Clydesdale Horse Society, which comments on the decline of the total number of horse stock in the State and the scarcity of good horses.

It is evident, therefore, that the cause of the decline in both quantity and quality must be looked for apart from the Horse Breeding Act. As indicated in previous reports the cause can be found by considering the law of supply and demand, bearing in mind that the supply cannot be made available until at least three and, on the average, four years have passed from the demand.

If the opinion of horse dealers can be taken as a true index of the position, then Victoria is steadily approaching the normal supply, both for quantity and quality, and the class of horse now available is of much more uniform character than that bred a few years ago. No one can deny that the teams now seen, especially about the streets of the cities, show considerable advance in quality on those of comparatively recent times.

The principal grievance expressed against the Act has been against the rejection of stallions for being "below a standard which conforms to a reasonable standard as regards breed, type, and conformation." This expression is the legal definition of "Scrubber"—a much more expressive and better understood term, and one which, if used, would not be a cause of complaint, since even opponents of the Act are of opinion that a "scrubber" should not be used as a sire. It is the getting rid of these "scrubbers" that is sought by the examination, and their elimination has become a factor equally important with the elimination of unsoundness, since the latter has been very considerably reduced, and the time is approaching when it will become a negligible factor. "Type," as meaning the fashionable horse of clean Clydesdale character, is not influenced by the examining officer—that is entirely a matter determined by the breeder and expressed by judges in the show-ring, with the result that the apparently lighter horse predominates.

It has been contended that veterinary surgeons are not competent to act as judges, and that a Board should determine the question as to whether a stallion is of suitable "type and conformation" under the Act. If, in the course of their education, they did not learn the principles of breeding and judgment of character, the experience they have gained in Victoria during the past fourteen years in their contact with breeders and judges throughout the whole State, would at least enable them to recognize a "scrubber." Mistakes may, of course, be made, but that it is not common is seen by considering the number of rejections and appeals. The Act provides that if an owner is dissatisfied he may appeal, and then a Board makes a determination.

That the majority of stallion owners are satisfied may be inferred, since out of 92 rejections of draught stallions during the past three seasons, only fifteen appeals have been lodged. Four of these have been successful, and in eleven cases the Boards have upheld the opinion of the veterinary officer.

If, as has been suggested, a Board travelled with the veterinary officer, the cost of examinations would be very considerably increased, and the additional expense would, of course, be borne by the industry in the form of heavier fees. Those who advocate this system probably do not realize what it would entail. There are three veterinary officers, and frequently four, engaged at examination parades of stallions during a period of three months of the year; and, in addition, there are a large number of single and special examinations made. As with each veterinary officer a judge of draught horses and a judge of light horses would be required, the services of eight judges in all would be necessary, with fees and expenses amounting to at least £1,500 per annum. Even then, decisions would not be final any more than at present, and no doubt the appeal sections of the Act would be invoked. Thus, the additional sum of £1,500 would be spent, if not in vain, at any rate, without any commensurate gain.

One view expressed by those who consider the Act to blame for the scarcity of stallions is that breeders will not enter the business of stallion owners owing to the fear that a horse granted a certificate as a three-year-old may be rejected at a subsequent examination on the grounds of disapproval, i.e., he may be declared to be below standard. The extent to which subsequent rejection after registration occurs is set forth in the following tables:—

Rejections of Previously Registered Stallions.

DRAUGHT HORSES.

In 1920–21	46	3-year olds registered.				In 1921–22	4	rejected,	3	unsoundness,	1 D.A.P.
In 1920–21	54	4	„	„	„	In „	8	„	8	„	0 „
In 1921–22	73	3	„	„	„	In 1922–23	7	„	5	„	2 „
In „	45	4	„	„	„	In „	3	„	2	„	1 „
In 1922–23	111	3	„	„	„	In 1923–24	9	„	4	„	5 „
In „	66	4	„	„	„	In „	8	„	6	„	2 „

REJECTIONS OF PREVIOUSLY REGISTERED STALLIONS.—*continued.*

LIGHT HORSES.

In 1920–21	21	3-year olds registered.		In 1921–22	3	rejected,	2	unsoundness,	1	D.A.P.
In „	27	4 „ „ „		In „	2	„	0	„	2	„
In 1921–22	24	3 „ „ „		In 1922–23	5	„	1	„	4	„
In „	23	4 „ „ „		In „	3	„	1	„	2	„
In 1922–23	29	3 „ „ „		In 1923–24	2	„	1	„	1	„
In „	25	4 „ „ „		In „	1	„	0	„	1	„

PONIES.

In 1920–21	9	3-year olds registered.		In 1921–22	0	rejected,	0	unsoundness,	0	D.A.P.
In „	16	4 „ „ „		In „	3	„	1	„	2	„
In 1921–22	8	3 „ „ „		In 1922–23	0	„	0	„	0	„
In „	17	4 „ „ „		In „	0	„	0	„	0	„
In 1922–23	20	3 „ „ „		In 1923–24	2	„	0	„	2	„
In „	12	4 „ „ „		In „	0	„	0	„	0	„

ALL HORSES.

In 1920–21	76	3-year olds registered.		In 1921–22	7	rejected,	5	unsoundness,	2	D.A.P.
In „	97	4 „ „ „		In „	13	„	9	„	4	„
In 1921–22	115	3 „ „ „		In 1922–23	12	„	6	„	6	„
In „	85	4 „ „ „		In „	6	„	3	„	3	„
In 1922–23	160	3 „ „ „		In 1923–24	13	„	5	„	8	„
In „	104	4 „ „ „		In „	9	„	6	„	3	„

The risk indicated in the above table, though not large, is one which does, no doubt, influence some who would otherwise become stallion owners. It has been suggested that compensation under such circumstances is warranted, and a Bill has been drafted for submission to Parliament to provide for this. Another suggestion is that a stallion, once registered, shall not at a subsequent inspection be rejected on grounds of "disapproval." This, to my mind, will not meet the position nearly so well. At the present time, it is not unusual for a horse to be submitted as a three-year-old which, in the opinion of the examining officer, is on the border-line—and he passes him with the object of giving him another year to develop. It is this class of horse which is subsequently rejected. Many do "make good," but a few do not. If the latter suggestion be adopted, the rejection of three-year-olds will become heavier, and the year of grace not allowed. Compensation appears to me to be the preferable system.

After considerable deliberation, the Committee previously referred to in this report made certain recommendations, to which consideration has yet to be given by the Minister. Summarized, the recommendations may be said to uphold the principle of registrtaion as carried out, with a few minor alterations.

Analysis of Last Season's Work.

In all, 258 parades were held during the 1923-24 season, and a total of 594 stallions were submitted for examination. Of these, 481 were registered, while the balance, 113, were rejected—46 on the ground of unsoundness, and 67 as being below standard or of "scrubber" type.

On the question of disapproval, the following table is instructive. It shows the rejections under this head for the four years the Act has been operative, together with the four years immediately preceding, during which examination was conducted under departmental regulations. There has been a steady decline in the percentage of rejections, particularly among draught horses, which receive far greater attention at the hands of breeders than light horses and ponies, many of which are kept for sentimental reasons.

The higher percentage rejected in 1920-21 was due to the fact that this was the first year that the registration of stallions was obligatory. Consequently, many that had previously been submitted and refused certification were again submitted for examination. The very steady decline is an indication that the type of horse in Victoria is slowly and surely improving.

	Percentage Rejections D.A.P.			
	Draughts.	Light.	Ponies.	Totals.
1916-17	21	45	41	30
1917-18	20	34	31	27
1918-19	17	26	30	22
1919-20	11	22	26	16
1920-21	18	27	26	23
1921-22	11	24	20	17
1922-23	10	22	33	17
1923-24	6	20	10	11

Under the heading of unsoundness, a total of 46 stallions was rejected—35 draughts, 10 light horses, and one pony.

As in all previous years, draught horses have the highest percentage, and this because of their predisposition to sidebone. During 1922-23, 13.5 per cent. were rejected; of those 12.1 per cent. were on account of sidebone; whilst for the past season only 9.8 per cent. were refused registration, and of these 5.34 per cent. were for sidebone. For the past four years, there has been a steady decline in the number of sidebone horses examined. In 1920-21, it was 25 per cent.; in 1921-22, 16.7 per cent.; in 1922-23, 12.1 per cent.; while for 1923-24, as stated above, it was 5.34 per cent.

Last season stood out as one in which a comparatively large number of draught horses were affected with ringbone. There were 9, or 2.5 per cent. rejected, as against 3, or .8 per cent., the previous year.

In light horses, bone spavin and ringbone are again responsible for the major part of the rejections; but there is a considerable reduction noted—5.7 per cent. only being unsound, as against 11.0 per cent. the previous year. Only one pony was rejected, and the reason for rejection was cataract. The total number of registrations made last year was 1,600, or 35 more than in the previous year.

TABLE SHOWING DETAILS OF EXAMINATIONS.

	Draught.		Light.		Pony.		Total.	
	Examined. 356	Certificated. 297	Examined. 174	Certificated. 123	Examined. 64	Certificated. 56	Examined. 594	Certificated. 481
	Rejected.	Per cent. Rejected.	Rejected.	Per cent. Rejected.	Rejected.	Per cent. Rejected.	Rejected.	Per cent. Rejected.
Bog Spavin ..	1	·28	..	..	..	..	1	·17
Bone Spavin ..	..	..	3	1·72	..	..	3	·50
Cataract ..	..	..	1	.57	1	1·56	2	·34
Curb	1	·28	1	·57	..	..	2	·34
Ringbone ..	9	2·53	5	2·87	..	..	14	2·36
Roaring ..	1	·28	..	..	..	..	1	·17
Shivering ..	2	·56	..	..	..	..	2	·34
Sidebone ..	19	5·34	..	..	..	..	19	3·19
Stringhalt ..	2	·56	..	..	..	..	2	·34
Through unsoundness ..	35	9·83	10	5·73	1	1·56	46	7·75
Through disapproval ..	24	6·74	36	20·69	7	10·94	67	11·28
Total ..	59	16·57	46	26·42	8	12·50	113	19·03

Appeals.

Sixteen appeals were lodged against the decision of veterinary officers. In six cases certification was refused on the ground of unsoundness, and in ten cases the reason given for rejection was "disapproval."

The Boards appointed to consider the cases upheld eleven of these decisions, and reversed five, and granted certificates.

Parades for Coming Season.

The time-table of parades for the coming season published in last month's *Journal* has been arranged so that every centre in the State may, if required, be visited. Owners of stallions should study the schedule of parades, and having decided at which they will present their stallion, insert the name of that place in the space provided therefor in the form of application for registration.

It will not necessarily follow that because a parade is listed in the schedule that a veterinary officer will attend there. In fact, if no owner has notified his intention of presenting his horse there, an officer will not attend. If a parade be not held on the date set down, it may be impossible to arrange for a second one until after the season has opened, as the Veterinary Staff will be fully engaged right up to the time of the Royal Show.

Application for registration should be made before the 1st July, and if owners comply with all requirements the veterinary officers will be prepared to inform them of the result of the examination on parade day.

Forms of application may be obtained from secretaries of Agricultural Societies and from the officer in charge of all police stations, to whom I desire to again record my thanks for assistance during the past year.

All registrations except those made after the 1st April of this year automatically terminate on 30th June next. Owners should carefully note that if a stallion changes ownership in any way the registration will expire within thirty days, unless due notice is given and the certificate of registration suitably indorsed.

THE TOBACCO INDUSTRY.*

By Temple A. J. Smith, Tobacco Expert.

The history of tobacco production in Victoria shows that many fluctuations have taken place in respect to areas under cultivation and values received for the crop. Especially was this the case until recent years, when guaranteed prices have been obtainable for tobacco leaf of certain standards. Up to the beginning of the present century at least ninety per cent. of the tobacco grown was produced by Chinese, chiefly on the share system, and they always endeavoured to get the heaviest yield possible with the least expenditure. Only rich river flats were used, with the result that very coarse, heavy, dark tobacco of low grade was placed on the market, and low prices were obtained. The method of curing was crude, air-drying being the system adopted, and manufacturers found that they could only use a small proportion of such leaf, as the smoking tastes of the public were fast inclining towards the lighter and brighter types of tobacco.

During the past ten years a very great improvement has taken place in the quality of Australian tobacco—an improvement brought about by the use of superior varieties and better systems of cultivation and handling. The main reason, however, has been the adoption of flue-curing instead of air-curing, and it is also noticeable that the proportion of European growers is to-day reversed, and comprises at least 90 per cent., as against 10 per cent. formerly. Instead of being an adjunct to other farming pursuits, tobacco-growing is now often made the chief money crop, and some fine returns have been obtained. Values have risen from 4d. and 6d. per lb. to 1s. and 2s. 6d. per lb., and in some cases 3s. during the last five years, and a guarantee for three years of up to 2s. 6d. per lb. for good leaf has been given by the leading manufacturers; consequently growers are in the happy position of knowing what their crops should be worth to them provided they produce tobacco of good quality.

Australian smokers are said to smoke a better-manufactured tobacco than any other people; therefore it is especially necessary that leaf of good quality only be grown for home consumption. During my recent visit to the United States of America I noticed that many types of tobacco were produced, some of them of inferior quality, but many of these are grown for export to Germany and other countries, where low-grade tobacco is smoked, and even in America, with her mixed population, which includes millions of negroes, Japanese, Mexicans, Portuguese, and others, there is a market for the inferior kinds.

The best tobacco leaf in America is grown in the same latitude as that of the north-eastern portion of Victoria and southern New South Wales, but on land very inferior in fertility to those in use in this country. In the famous old Piedmont belt, in Virginia, the soils on which the best cigarette and pipe tobaccoes are grown is from 80 per cent. to 90 per cent. sand overlying a porous sub-soil of grey, yellow, or light-red colour, naturally well drained and with a small moisture-holding capacity. River flats are not used to any extent, but almost

* Paper read at the Farmers' Annual Convention, Benalla, April, 1924.

all the tobacco is grown on the uplands at altitudes varying from 500 to 1,500 feet above sea level. These soils are so poor in quality that even with the aid of fertilizers they will not produce more than from 15 to 20 bushels of maize per acre, or from 10 to 12 bushels of wheat.

Tobacco is the farmers' money crop, and only one is grown in each three-year rotation, the other two years being devoted to building up the land for the third season's tobacco crop. The usual preparation is to grow maize and velvet beans the first year, followed in the second year by rye or Herds grass, the sod being turned down to supply humus. The tobacco crop is never allowed to immediately follow legumes, as too much nitrogen in the soil has a detrimental effect on the colour and quality of the leaf. It is claimed also that a proper rotation helps greatly to assist in the control of disease.

The system of cultivation is very much the same as is followed here, except that the tobacco is planted on ridges hilled up with a special plough. This system is necessary in America, owing to the heavy thunder-storms which occur frequently, and which would smother the young tobacco plants if they were planted on the level. The level system, however, will give the best results in Australia. It is in proper fertilizing that the local grower has most to learn.

No grower in Virginia and the Carolinas thinks of growing tobacco without a liberal system of fertilizing—in fact, he supplies a much larger amount of plant food than is actually required for the growth of the crop. Anything less than 400 lbs. of superphosphate, 150 lbs. of nitrate of soda or some other nitrogeneous fertilizer, and 100 lbs. of sulphate of potash would be considered futile. At first sight this quantity appears excessive, but many farmers use more than double these quantities, and have proved over many years that it pays to do so. They claim that large amounts of superphosphate have an effect on the crop altogether apart from its value as a plant food, and that it will help to ripen the tobacco four to five weeks earlier, and improves both the colour and quality of the leaf. They also state that with heavy dressings of fertilizer a crop can be successfully grown with less rainfall—an important point with the Victorian grower. The saving of at least one month's labour in the field would go far towards paying for the extra fertilizer, and the minimized risk from loss by frost would also be a great advantage.

American growers burn their seed beds as a matter of course, and prefer new land as a site each year. All beds are covered with cheese cloth, or, as they term it, plant-bed cloth. Complete fertilizer is used on the beds at the rate of 1 lb. per square yard of bed, and I noticed that only the surface soil was worked, and that to a depth of about 3 inches. The covers are removed from the beds about ten days before transplanting in order to harden the plants. A system of planting out in wider rows, with the plants somewhat closer in the rows is being adopted by the best growers, who say that this practice allows the sun free access to the lower leaves, and thus ripens them better, and makes for sweeter leaf.

American growers top lower than is the custom here, leaving only from 10 to 14 leaves at most on a plant. This has the effect of ripening the plant earlier and more uniformly, and means a saving of labour without sacrificing any of the crop. By means of the leaf-pruning

system crops are grown in the States in 90 days from the time of transplanting. The tobacco is placed in the curing barns much thinner than is the general rule in Australia, a practice which we could follow with good results.

Flue-curing is general, most of the barns being constructed of logs with all interstices well closed with mud. Curing is accomplished on much the same principle as that followed in Australia, but owing to the system of fertilizing and the use of lighter soils the leaf is more easily and quickly cured than is the case here, and a larger percentage of bright leaf is secured. When cured, the leaf is brought into order and carted to the warehouses for sale by auction on the loose-leaf floors, or taken to the huge co-operative warehouses. The system of selling appeared to me very imperfect, and the middlemen to be too much in evidence. Growers waste much time in taking small consignments of leaf in every few days instead of in parcels of larger bulk. The buyers fix prices, and the farmer seems to have nothing to say in regard to the value of his product. Grading is roughly done on the farm, and later the tobacco is regraded by the buyers, and prepared for sale overseas or elsewhere.

Tobacco-growers in America have to contend with many pests and diseases which are not as yet known in Australia, and I would like to emphasize the necessity for great care in the treatment of all seed imported to prevent the introduction of such diseases as wildfire, wilt, root rot, black schanck, &c. In fact, I would go so far as to advocate that all tobacco seed be grown, as far as possible, locally, and when importation becomes necessary, that the seed be brought through the Department of Agriculture, and properly treated before sowing, so as to destroy any probability of infection. The methods employed in regard to the most serious diseases appeared to be the breeding and selection of varieties resistant to the various diseases experienced, and this has been successfully accomplished in many cases. Work is being done in Victoria at the present moment along these lines in connexion with the one serious trouble tobacco-growers have to contend with, viz., blue mould.

A few figures showing the extent of the tobacco industry in America may be interesting as evidencing the possibilities in Australia in the future. There were 448,572 farms growing tobacco in the United States of America, and 1,951,000 acres under the crop in 1919. The crop totalled 1,465,481,000 lb., valued at £114,000,000 sterling. The individual areas are small, averaging 7 acres per farm. In Victoria alone we have easily 500,000 acres, and probably more, that will grow tobacco. We can improve our product from 25 per cent. to 50 per cent. by growing on lighter soils, by using fertilizers in greater quantity, and by handling our crops to better advantage. Victorian tobacco-leaf samples submitted to experts were highly commented upon.

I would like to see our tobacco properly graded in central warehouses by skilled graders, and sold in such houses, so that each grower could see his own and his neighbour's leaf marketed, and in this way learn the types and grades required by manufacturers. I believe such a system would be highly educative to growers, and would prove satisfactory to the buyers. On the whole, our growers are getting a better sale for their leaf than those in the United States of America, but they

will have to concentrate on the production of as high a grade of leaf as possible to meet local requirements.

In conclusion, I would like to say that I saw many States in America and much of existing conditions of labour, and I do not think coloured labour good or efficient as compared with white. I think our policy of a White Australia a right one, and I believe we have a country as good as America. All we want is a population of a few more millions; but, for the sake of future generations, let us keep it white.

PREHISTORIC HORSEMEN.

The origin of the horse is a subject of never-failing interest to those who recognise the great part which he has taken in the world's history. There are theories that the tarpan, which is yet to be found in large hordes in the steppes of Russia and Asia, though considerably reduced in numbers in late years, was the original horse, and many circumstances go to prove that the original horse was small in stature and that he has developed size as years rolled on.

Many erudite books have been written on the origin of the horse and of the origin of breeds, but even as regards the latter, which are, comparatively speaking, of recent date, a great deal has to be left to surmise. It would seem from the discovery of some lacustrine relics in the neighbourhood of Parma in the course of last century that some of our preconceived ideas were at the best not very accurate.

It must have come as a surprise to those who did the research work that the lake dwellers were horsemen. Horses were found in their burial places, and the Rev. Baring Gould, who is an authority on antiquities, gives it as his opinion that the horses were the favorite horses of a chief or great man slain and buried with him. He also points out that these people had two kinds of horses, one on powerful lines and the other small and light in bone. This is interesting, as it shows that all the prehistoric horses are not of the small pony type, as has sometimes been held. The question of the time about when these bones were buried has many points of interest. In the first place, the Roman and later remains were found at a depth of 4 feet, and these were the accumulation of 2,962 years. Then came the midden of the ancient inhabitants, three deposits separated by three thin layers of red sand or ashes, which was of a depth of 6 ft. 8 in. The latest bed of the lake, containing piles, was 7 feet lower, the secondary bed, containing piles, was 3 ft. 3 in. lower, and the original bed of the lake was 21 feet from the surface.

The lake-dwellers were no more known after about 1040, so that gives us 2,962 years since their disappearance, and presuming, as we fairly may do, that the rate of accumulation was the same before as it was during and after the Roman period, we get back to a period approaching 8,000 years. It is very interesting to know that between seven and eight thousand years ago there were two breeds of horses clearly distinct in type, and that the horse was so highly appreciated as to be slain and buried with his owner.

RUPANYUP CROP AND FALLOW COMPETITIONS, 1923.

Report of the Judge, Mr. H. A. Mullet, B.Ag.Sc., Senior Inspector of Agriculture.

The present competition is the fifth of the kind organized by the Rupanyup Agricultural Society since 1919. In my report, furnished to the Society last year, attention was drawn to the solid advances which have been made in the district within that time in three directions, each of fundamental importance in the growth of heavy crops of wheat, viz., the use of improved seed wheat, the more perfect tillage of the soil and the application of heavier dressings of fertilizer. Despite a season which was a severe strain on the resourcefulness of the farmers, crops have been raised which, once again, confirm those impressions. Except for occasional water-logged patches, especially on stiff red land, the roadsides between Murtoa and Rupanyup, and through the famous Lallat Plain

Mr. R. J. Jackson's Heavy Crop of Federation Wheat.

were lined with the usual short, dense, but clean crops of Federation wheat, which are now characteristic of well-farmed Wimmera land. Thus though the winter was unprecedentedly wet, and made late sowing—an integral part of the Wimmera system—difficult, the methods perfected for dry conditions were weather-proof save that an odd low-lying paddock could not be sown.

But while the progress has been satisfactory much yet remains to be done in the matter of raising generally the average wheat yields obtained to the level of those of the best farmers. Sometimes there are obvious peculiarities of soil which account for the differences, but just as often it is a question of method. Even in the case of some of the inferior types of soil much can be done to improve their fertility, but of that more will be said later.

The 1923 Competition.

Entries in the three wheat sections judged totalled 27—a respectable total, though a falling off from last year's 35. In section 1, the Brunton Cup, the whole of the wheat grown is judged for three successive years. The first competition of this type, commenced in 1920, was won last year by Mr. R. T. Jackson. This year a fresh start has been made for a new trophy presented by the same donors as before. There were nine competitors. In the section, "best 60 acres of wheat in one paddock," fourteen entries were judged and four in the section for repatriated soldiers.

Results.

THE WHOLE OF THE WHEAT GROWN FROM 1923, 1924, 1925, LIMITED TO COMPETITORS GROWING AT LEAST 100 ACRES ANNUALLY.

SECTION 1.—BRUNTON CUP.

The highest aggregate for 1923 was secured by Mr. James Crampton, of Lallat, who submitted 377 acres of splendid wheat to

Federation Wheat.—Mr. J. Chapman's, Rupanyup.

the judge; all save a small portion of Huff's Imperial consisted of the Federation variety. Considering the area, the wheat was wonderfully uniform and free from disease. In parts a few weeds were present and an occasional foreign head was met with. The yields should have been heavy. The heaviest paddock consisted of 187 acres of Federation. This was grown on black land that was summer-fallowed with a plough to 3½ inches deep in March and April then harrowed. In August weeds were turned under with a skim plough, followed by the harrows to break down the soil. During the spring months, in all three scarifyings were given as weeds appeared. A stroke of the harrows was given during harvest time, following on rain. The paddock was then allowed to stand until the autumn, when it was scarified up and sown with a combined-drill in June; 80 lbs. of pickled seed and 112 lbs. of superphosphate per acre were used.

Mr. E. T. Kendell was awarded 87 points for 215 acres, mainly of Federation. Though a few acres of the wheat had been seeded under unfavourable conditions, the heavy yield of the remainder was sufficient to bring the average up to a high level. The best crop appeared to be 135 acres of Federation sown on land winter-fallowed in July. This was followed by a skim plough in August, and, in October, the scarifier. In November it was partly worked over with a combined drill, and then a stroke of the harrow was given, and another just after harvest. In Autumn the soil was harrowed and the crop sown in June with a combined-drill; 80 lbs. of seed were used per acre, with 130 lbs. of superphosphate. Then follow Mr. J. Chapman, Messrs. Hemphill Bros., and Mr. F. E. Lannigan, 85 points each

DETAILS OF AWARD. SECTION 1.—BRUNTON CUP.

For the whole of the wheat grown 1923, 1924, 1925, limited to competitors growing at least 100 acres annually.

Name.	Yield.	Type.	Absence of Weeds.	Disease.	Evenness.	Allowance for Refractory Red Soil.	Total.
Possible Points ..	**35**	**20**	**15**	**15**	**15**	..	**100**
J. Crampton ..	35	17	11	15	15	..	93
E. T. Kendell ..	32	17	12	14	12	..	87
J. Chapman	27	18	13	13	14	..	85
Temple Bros. ..	30	16	12	14	13	..	85
F. E. Lannigan ..	30	19	9	14	12	Plus 1	85
J. P. Loats	31	16	12	11	14	..	84
C. Carra	26	19	13	12	12	Plus 1	83
A. Chapman ..	27	19	10	11	13	..	80
R. Jackson	24	19	12	13	10	..	78

RESULT, SECTION 2, BEST 60 ACRES OF WHEAT IN ONE PADDOCK.

Mr. James Crampton was awarded 96 points and first prize for portion of the 187 acres of Federation grown on summer fallow as previously described. It was a fine thick prolific crop with deeply coloured heads.

Mr. C. Carra gained 93 points and second place for a 60-acre paddock of Federation on what is practically new land. The soil is a brown clay loam typical of that clothed with buloke timber. The wheat was well headed, the grain hard and shotty, and it was quite free from foreign heads, so that it should make excellent seed. The paddock was winter-fallowed in July, then harrowed twice in the spring, and again in the summer. In the following May it was scarified and sown early with a combined-drill between the end of May and the first week in June. Ninety lbs. of seed per acre was applied, but only a light dressing of superphosphate—about 45 lbs. The balance of Mr. Carra's wheat on older land was sown at the rate of 90 lbs. of seed with 140 lbs. of superphosphate.

Mr. G. L. Crommie was awarded 93 points and third place for his No. 2 entry of Federation. The yield was high, the crop reasonably

pure, and exceptionally regular, and quite free from disease, although points were deducted for the presence of weeds, mainly mustard. This crop was grown on winter fallow moderately well worked. It was sown in mid-June with a combined drill, using 75 lbs. of seed per acre, with 120 lbs. superphosphate. A second entry of Federation sown later did not appear nearly so heavy, as it was drilled under unfavorable conditions. However, the wheat having been obtained direct from Longerenong College the purity left nothing to be desired, and there was a noticeable reduction in the number of weeds present.

Mr. D. H. Jones' crop of Federation was grown on well-worked winter fallow. It was sown in mid-July with from 70 to 90 lbs. of seed per acre—increased towards the end of the paddock—and with from 112 to 130 lbs. superphosphate. The purity of the wheat was excellent, and weeds were non-existent. Prior to drilling the crop three strokes of the scarifier were given in the autumn to kill rubbish as it appeared.

Mr. Dunlop's Federation was notably pure and regular. Points were deducted for the presence of patches of mustard. The crop was grown on summer-fallowed land, well-worked and drilled during the first week of July with 80 lbs. of pickled wheat and 100 lbs. of superphosphate per acre.

DETAILS OF AWARD—SECTION 2, BEST 60 ACRES OF WHEAT IN ONE PADDOCK.

Competitor.	Variety.	Yield.	Trueness to Type.	Absence of Weeds.	Disease.	Evenness.	Total.
Possible Points ..	..	**35**	**20**	**15**	**15**	**15**	**100**
J. Crampton ..	Federation	35	18	14	14	15	96
C. Carra	,,	31	20	15	13	15	94
G. L. Crommie (No. 2)	,,	33	18	12	15	15	93
D. H. Jones ..	,,	31	19	15	14	14	93
A. Dunlop ..	,,	32	19	11	13	14	89
R. J. Jackson ..	,,	25	19	15	14	15	88
R. F. Hurley ..	,,	32	17	15	9	14	87
Hemphill Bros. ..	,,	26	19	14	13	15	87
G. L. Crommie (No. 1)	,,	24	19	14	15	15	87
J. T. Sweetman ..	,,	30	19	10	13	13	85
H. Newall ..	,,	22	18	14	12	15	81
A. Dunlop (No. 2) ..	,,	22	19	12	13	15	81
J. Chapman ..	,,	21	17	13	13	14	78
N. Newall ..	,,	22	17	12	13	11	75
A. Chapman ..	,,	19	19	12	11	14	75

RESULTS SECTION 5 FOR REPATRIATED SOLDIERS—WHEAT CROP ON WHOLE OF FALLOWED LAND.

This section was not so well contested as in other years. The crop exhibited by Mr. E. T. Kendell, which was awarded second prize in the Brunton Cup, was placed first with 89 points. Mr. A. G. Swan was second with 86, and Mr. F. Nicholson third with 83. The winning crop has already been described. The second prize crop—Federation—was 100 acres in area, 50 acres were summer-fallowed, and 50 acres contained a patch of red soil winter-fallowed; the summer fallow was skin-ploughed

in March, consequently both portions were worked similarly. In July and August the land was ploughed, then harrowed, skim-ploughed in September and October, harrowed, scarified, and harrowed. During some damp weather in February a stroke of the harrows was given, and in May the land was worked up with a scarifier, and later sown with a combined drill with 80 lbs. of seed and 90 lbs. of superphosphate per acre. Mr. F. Nicholsen, whose farm is 200 acres only, showed 80 acres of Federation, sown on well-worked winter fallow. In all thirteen cultural operations had been given the land; 80 lbs. of seed and 90 lbs. of superphosphate were drilled per acre. The seed had been obtained from Mr. R. J. Jackson, the winner of the first Brunton Cup, and its purity was good. Mr. Baylie's crop was also a satisfactory one, especially in view of the fact that nearly one-third was sown on red land. On the black soil an excellent crop of Federation had been raised. This latter paddock was ploughed in June and July, then harrowed twice. In the spring a scarifying was given, followed by a stroke of the harrow. In

Contented Stock—Rupanyup.

the autumn, after the first rain, the paddock was re-scarified and sown with a combined-drill between the last week in May and the last week in June; 65 to 70 lbs. of seed were used with 100-112 lbs. of superphosphate.

DETAILS OF AWARD—SECTION 5—REPATRIATED SOLDIERS—WHEAT CROP ON WHOLE OF FALLOWED LAND.

Name.	Yield.	Trueness to Type.	Absence of Disease.	Absence of Weeds.	Evenness.	Total.
Possible points ..	**35**	**20**	**15**	**15**	**15**	**100**
E. T. Kendall ..	34	17	12	14	12	89
A. G. Swan	29	18	13	13	13	86
F. Nicholson	28	19	11	13	12	83
G. Baylie	26	17	12	13	13	81

ELMORE CROP AND FALLOW COMPETITION.

Report of the Judge, L. C. Bartels, B.Ag.Sc., Science Field Officer.

There has been a notable advance in the standard of wheat farming in Victoria within recent years, and in places, land which has been cropped off and on for 40 years, is bearing better crops than ever, following on the adoption of improved methods.

It will be seen that the best crops inspected at Elmore include two or three grown on new land, which was not a triumph for method, but all the crops shown were of a fairly high standard, and a couple were excellent. Most exhibited some defect or another. There was the crop with an admixture of foreign wheat, the crop badly affected with bunt, one or two were dirty with wild oats, and some showed irregularities.

The variety Federation holds pride of place, and farmers will do well to continue growing it till they are convinced that better wheats are available. They should, however, be alive to the fact that a constant endeavour is being made to improve the standard varieties, and many new wheats are emerging from their trials which bid fair to surpass even Federation. For these reasons the trial of new wheats on small areas is sometimes desirable.

It cannot be said that the fallows inspected were particularly good, although any one with a knowledge of the conditions confronting the farmer in the Elmore district would admit that many of them were creditable. The defects were not altogether through ignorance of what constitutes a good fallow, but rather owing to difficulty in achieving the desired end.

Some of the Wimmera farmers go near to maintaining perfect fallows, though it has to be admitted that natural conditions favour them to some extent; but it is only by constant attention and judgment that they obtain their results, and Elmore farmers must be prepared to give due attention to their fallows if their full value is to be realized. What should be sought is a middle course between a too-finely worked fallow and one left too rough.

During the period when wind and sun combine to hasten evaporation, the surface soil should be kept in a loose condition, free from clods and yet not so fine that it will run together after a shower.

Land that is ploughed too wet is sometimes left in the sod so long that breaking it down is a matter of great difficulty.

No definite rule can be laid down. The farmer must be guided by circumstances, and the work of implements does not depend so much on their type as on the condition of the soil when it is worked. In this regard it is noteworthy what splendid results can often be achieved with the harrows, which can cover the ground quickly and so permit of advantage being taken of favorable conditions. Sheep should be used to keep down weeds. When weeds develop, the farmer must have resource to some implement adapted for their destruction. Two or three farmers in the competitions have used a Wimmera scarifier to advantage during the past season, and there can be no doubt that that implement or some modification of it will do good work at Elmore.

With regard to time of sowing, it does not follow that because late sowing has been found to be profitable in the Wimmera that the same results would follow its adoption at Elmore. Experiments at Wyuna, conducted for some three or four years under conditions comparable with those at Elmore, showed that wheat sown in May gave higher yields than wheat sown in June.

Investigations at Wyuna into the comparative value of light and heavy manurings demonstrated what has been proved in almost every instance where such tests have been made—that on "old land" the rate of manuring may be with advantage raised to 1 cwt., and even 1½ cwt., per acre, providing good cultural methods are adopted.

The majority of farmers at Elmore pickle their seed wheat, and, in consequence, very little ball-smut was to be seen. Still, some of the newer settlers do not appreciate the importance of this operation,

Mr. H. Burley's Crop—Lake Cooper.

and one crop inspected was badly infected. The results will, unfortunately, be a severe lesson to the grower. At least one new settler who exhibited crop neglected to pickle his seed, but produced a clean crop. If he regards only his own experience he may think that he may with impunity omit pickling every year, but it must be stressed that the freedom from bunt is maintained only by careful and consistent pickling, and no circumstance, such as sowing dry, removes the necessity. True, smut-free crops have been produced from smutted grain, and unless there is infection of the seed, the disease does not develop spontaneously, but it must be remembered that one obscure smut ball contains sufficient spores to infect a bag of wheat. By far the greatest number of farmers use formalin in ¼ per cent. solution. Some still use bluestone. The latter may be employed to advantage at the rate of 1 lb. of crystals to 8 gallons of water. Of greatest importance is the method of pickling; machines

on the market facilitate the operation, but as good results may be obtained without them. The wheat should be poured into the solution and stirred, remaining immersed for three minutes. Bunt balls will float on the surface of the liquid, and must be removed.

The advent of powdered copper-carbonate as a fungicide deserves mention. Last season 16,000,000 million acres were sown in America with dry pickled wheat, and although the method was discovered by an Australian—Dr. Darnel Smith, of Sydney—in 1919, it has to be admitted that Australian farmers are slow to adopt it.

Copper-carbonate costs about 2s. 8d. per lb.; from 1 ounce to 2 ounces is used per bushel of wheat. It is dusted on the seed, and this operation may be performed months before sowing; it has no injurious effect on germination, and it is immaterial in regard to its efficacy whether the wheat is sown on a dry or moist seed bed.

Mr. Ayson's Crop of Federation.—A Splendid Exhibit.

Several inquiries were made about "footrot"—a disease in wheat which was present to a slight extent in only one competition crop, but which had badly affected a few crops in the district, and in other years has been particularly severe. Mr. W. J. Murphy has observed that crops on "newer" land have gone down, and that crops of Major and Yandilla King were very susceptible. This disease is distinct from "take-all," but its effects are much the same, and it is to be combated in the same way:—

(1) By fallowing and good cultivation methods, which permit the rotting of old stubble and the preparation of a firm seed bed.
(2) By following a rotation of crops, including oats.

Mr. Burley's winning crop of Yanward was the most striking crop inspected. It was tall, regular, and dense. A few wild oats scattered through it were overtopped by the wheat. There was an almost entire

absence of undergrowth, and the foliage was very clean, although an odd plant showed disease. Except for a rare tip-bearded head, the wheat was uniform in type.

The land bearing this crop was ploughed in February, 1922, and harrowed twice before June. It was spring-tooth cultivated in September, harrowed in March, 1923, and again in April spring-toothed preparatory to sowing, and sown at the end of June with the "combine." Fifty-eight lbs. of seed per acre and 40 lbs. of manure were used. The seed was pickled with formalin. The land was harrowed after drilling, and the young crop fed off in September, after which it was rolled. The crop was grown on the shore of Lake Cooper on very good soil. This soil is different from most in the Elmore district, and Mr. Burley considers that 40 lbs. of superphosphate per acre is ample. He has a variety of implements which he uses to meet conditions, *e.g.*, he

Mr. Waterman, a Soldier Settler, Showed a Dense Crop of Federation Wheat.

uses disc cultivators, spring-tooth cultivators, scarifier, and a six-furrowed pronged plough. He is an advocate of the "combine" as being a time and labour saver.

Mr. Ayson's crop of Federation was a splendid exhibit, it was particularly free from wild oats. An odd thistle was seen, but very little undergrowth. It had been carefully sown, but was somewhat irregular in height. An odd foreign head showed up, but beyond a little loose smut the plants were free from disease. This crop gave promise of a high yield, and seemed a little more forward than other crops inspected. It was grown on new ground broken up in June, 1922, harrowed after ploughing, and spring-tooth cultivated in October. Before sowing the ground was again spring-toothed. Seventy lbs. of seed per acre was put in, with 80 lb. of superphosphate. Mr. Ayson usually applies 100 lbs. of superphosphate to "older" land. He grows

Yandilla King and Major wheats, and likes them, although he has found Major subject to flag smut. His choice of Federation for the new ground was because it would not grow too tall.

Mr. Waterman showed a dense crop of Federation, uniform except for a few misses in drilling. No bunt was observed, but loose smut and flag-smut were in evidence. A number of foreign heads appeared in the crop, and weeds present included wild oats, barley, and saffron thistles, and, in patches, cluster and woolly clovers.

This crop was grown on new ground ploughed in October, because it could not be done earlier. The land lay in the sod, and was harrowed twice just before cropping. The wheat was sown in May—seed, 65 lbs.; superphosphate, 35 lbs. The seed was not pickled. Mr. Waterman favours early sowing, and intends to increase the rate of manuring.

Mrs. O'Brien's entry was a fairly good crop of Federation, but the prevalence of wild oats marred its appearance. There was also a fair amount of mustard, thistles, and undergrowth. The crop was heavy and uniform, but some misses in drilling were observed. A few plants showed "footrot," but no other disease was noticed. The wheat had a few "strangers" scattered throughout.

Mr. T. Houlden's, sen., fallow had a good appearance. A nice knobby mulch of the right depth overlay—a compact seed-bed containing a fair amount of moisture. There was an almost entire absence of weeds, and the cultivation had, apparently, been regular. The texture of Mr. Houlden's land was modified by the occurrence of pellets of buckshot throughout. These would help in achieving the condition presented. The land had been ploughed at the end of August and beginning of September with a mould-board plough, harrowed and spike-rolled, and later harrowed again. Mr. Houlden favours ploughing to a depth of from 4½ to 5 inches with the mould-board plough.

Mr. W. Murphy ploughed his fallow land in August with the mould-board plough to a depth of 4½ inches, harrowed it in September, and scarified it in October with a Wimmera scarifier. He had reduced the land to a fair tilth, although it was cloddy in places and the seed-bed was ridged, indicating uneven working. There was a fair conservation of moisture, and only an odd weed was seen. The mulch was on the deep side.

Mr. J. Cheatley showed a very clean area of fallow. The surface had been allowed to crust, although the mulch was still preserved and was of nice depth with a fairly level seed-bed beneath of moderately good moisture content. He had ploughed the land at the end of September to a depth of 4½ inches, and had harrowed it twice after ploughing. Mr. Cheatley favours the use of the mould-board plough, likes to plough the ground in moist condition, and considers that a lesser depth than 4½ inches might be sufficient.

Mr. D. J. Murphy showed a uniform piece of fallow, which was clean and had a rather good mulch, although a few lumps were apparent in places. The seed-bed was not compacted. The moisture conservation was fair. The land was ploughed in August with the mould-board plough—4½ inches deep—harrowed in September and again in October.

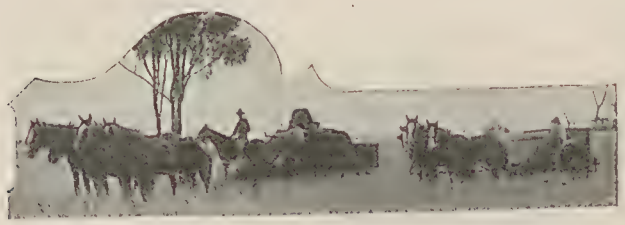
Details of Points Awarded.

I. BEST CROP OF 40 ACRES.

Name of Competitor.	Yield.	Purity of Type.	Evenness.	Absence of Disease.	Absence of Weeds.	Total.
Possible Points	**35**	**20**	**15**	**15**	**15**	**100**
Burley	35	19½	14½	14	13	96
Ayson	35	19	13	14½	14	95½
Waterman	32	18	13	14	12	89
Mrs. O'Brien	33	19	12	14	8	86
Chas. Butcher	32	14	12½	13	13	84½
Smith	24	19	13	10	13	79
Geo. Ingram	23	19	10	14	10	76

II. BEST FALLOW OF 40 ACRES—TO BE JUDGED IN CONJUNCTION WITH THE CROP GROWN THEREON IN 1924.

Name of Competitor.	Moisture.	Mulch.	Cultivation.	Absence of Weeds.	Total.
Maximum Points	**25**	**25**	**25**	**25**	**100**
T. Houlden, senr. ..	22	23	22½	24	91½
W. Murphy	23	22	22	24	91
J. Cheatley	22	22	22	24½	90½
D. J. Murphy	22	22	22	24	90
D. I. Trewick (A exhibit) ..	21	22	21½	24½	89
J. J. Quinn	20	23	22	24	89
Chas. Butcher	22½	22	22	22½	89
H. Cheatley	23	21½	21	23	88½
Chas. Houlden (B exhibit)	21	21	22	24	88
Geo. Houlden	23	23	22	20	88
Chas. Houlden (A exhibit)	22	23	22	20	87
G. A. Ingram	21	21½	21½	23	87
D. I. Trewick & McKee ..	20½	19	19	19½	78



NEW CROSSBRED WHEATS.

Tests at Carwarp.

Field experimental plots have for some time been conducted by the Department of Agriculture on the farm of Mr. P. G. Stewart, M.H.R., of Carwarp, to determine the relative yielding capacity of a number of new crossbred wheats produced by the Department, in comparison with yields from standard wheat varieties.

Tests were also made of the value of light and heavy dressings of superphosphate on the newer Mallee areas.

During the past few years a large number of new crossbred wheats have been produced and fixed by the Department at Werribee and Longerenong. It does not necessarily follow that a wheat which gives good returns in the Wimmera or in the costal district will also yield well under the dry conditions prevailing in the Mallee. Hence the suitability of the new crossbred varieties for arid conditions could be determined only by actual test.

Twenty-four new crossbreds were tested in competition with wheat varieties commonly grown in the Mallee. The seasonal conditions were not highly favorable for wheat production owing to the very dry weather experienced during October and December. The rainfall from seeding to harvesting was 6.28 inches, of which 4.02 inches fell in June and July. The results were as follow:—

Name.	Pedigree.	Yield. bus.	lb.
Nizam	Indian 17 x Federation	27	45
Ghurka	Gallipoli x (Currawa x Indian 4)	26	30
Nabob	Indian 17 x Federation	26	21
Mahratta	Indian 17 x Federation	25	21
Sepoy	Currawa x Indian 4 x Federation	24	15
Confederation	Federation x Federation	24	12
Yandilla King		24	6
Omrah	Rajah x Ranee	23	30
Mogul	Indian E x Telfords No. 77	23	12
Federation		23	6
Alliance	Federation x Federation	23	3
Sovereign	Penny x Canberra	22	36
Capitol	Hard Federation x Canberra	22	0
Marmora	Gallipoli x College Eclipse	21	42
Mac's White		21	42
Mahdi	Indian 17 x Federation	21	15
Ranee	Indian F x Federation	20	39
Suvla	Gallipoli x College Eclipse	20	24
Empire	Federation x Dart's Imperial x Federation	20	21
Currawa		20	18
Rajah	Indian E x Telfords	20	9
Parsee	Hard Federation x Indian H	20	9
Krithia	Gallipoli x Federation x Federation	19	33
Viceroy	Federation x White Fife	19	30
Graham		19	3
Gluyas		18	6
Gallipoli	Clubhead x Yandilla King	17	54
Penny		17	3
Sterling	Stanley x Bobs	15	30

Average yields—Standard wheats .. 20 bus. 32 lbs.
Crossbred wheats .. 23 bus. 44 lbs.

Six standard wheats largely used in the Mallee, namely, Mac's White, Federation, Yandilla King, Penny, Gluyas, and Carrawa, gave an average yield of 20 bushels 43 lbs. per acre. The average of the 24 new crossbred wheats was 23 bushels 44 lbs., an increase of nearly 15 per cent. on the standard varieties used in the district.

The land on which the plots were sown was red sandy loam, characteristic of a large area of the new Mallee country.

The results of these tests are of interest, because they show that the crossbreds which gave best results last year were those containing a strain of Indian wheat in their pedigrees.

In view of the low rainfall between seeding and harvest (6.28 in.) the yields of the crossbreds may be considered as very satisfactory. It is intended to make trials on a wide scale with a number of these new crossbreds.

DOOKIE FALLOW COMPETITION.

Report of the Judge, H. A. Mullett, B.Ag.Sc., Senior Inspector of Agriculture.

Following on the success of the record wheat crops raised on the black soils at Dookie last year by the use of unmodified Wimmera methods, increased interest was shown in the present fallow competition, the judging of which had to be deferred from December, 1923, because of rain. The yields obtained on the black paddocks entered for competition by farmers, who adopted the new practices, ranged from 42 bushels to 54 bushels per acre, and averaged over 50 bushels per acre. The results were achieved by the use, in the main, of a nicely adjusted combination of summer fallowing, good tillage of the fallow, by liberal dressings of good seed and heavy dressings of fertilizer, and, above all, by late sowing. The latter practice was the most revolutionary of those introduced, but despite the comparatively backward appearance of the crops during August, it played the biggest part in the production of the short, dense, clean, and prolific crops, which filled the bag so well later on.

After this successful result of local enterprise, it is felt that the measure has been obtained of the black soil at Dookie, but what of the red soils which occur on most of the slopes, and the grey soils on the plains further out? Can the yields of these be increased? The answer is that, unquestionably they can, especially on the free-working red clay loams. The grey soils are poorer in plant food, and their physical condition is unsatisfactory, hence their improvement is a more difficult matter. For these the Wimmera style of cropping is obviously unsuitable. The red soils then offer the most promising fields for attack. In sowing wheat on them, almost the whole of the practices which suit the black soil could be adopted. Their texture permits of their being

summer-fallowed, and they should respond to heavier dressings of seed and fertilizer than is commonly used in the district, though it would be undesirable to sow wheat on them as late as on the black soil. One thing that strikes any one who has closely observed the crops of wheat grow on the land, and compares them with crops grown on virgin soil in the same district, is their comparative thinness and general lack of vigour. Closer inspection reveals that diseases like take-all and flag smut, particularly this latter, are making their presence severely felt. Most of the paddocks have been very closely cropped to wheat for very many years. What they need is a change of crop. The texture of the soil suggests that the stores of humus have been reduced considerably; the change of crop, then, should provide for the gradual restoration of the organic matter of the soil. The rainfall at Dookie averages 21 inches per annum, and this assures the success of most autumn and spring forage crops. Rape, oats, and peas are forage crops which should be exploited more at Dookie. They will be found profitable crops to grow, and will improve the fertility of the soil, and consequently the yields of wheat the next time the paddock is cropped.

Judging the Fallows, 1924.

Eleven entries were inspected; five were on black soil, five on red clay loam, and one on grey sandy loam. All were entered in the one class and, hence, had to be judged under the same scale of points. As there had been unusual rains throughout the summer months, which are normally dry, recourse had to be made to the soil auger and laboratory analysis of the samples to obtain comparisons of the water content. The water-holding capacity of the three types of soil varied greatly. Messrs. Bennett Brothers, No. 1 entry of fallow, was found to contain 28.4 per cent. of moisture, which is close to the total saturation limit, for this soil. On the other hand, their red paddock contained only 18.2 per cent. of water, but it also was approximating saturation. The much greater capacity of the black soil for water is, of course, one of the factors responsible for its great productivity. In general, the analysis showed that, apart from the nature of the soil, the kind of cultivation given the soil contributed most to its water content.

Results.

Messrs, Bennett Brothers obtained first place, and 97 points for their No. 1 exhibit (black soil). The moisture content was very high indeed, the mulch was mellow and about 2½ inches deep, and the cultivation had been regularly and carefully done. There was excellent consolidation below the mulch. A point or two was deducted for the presence of a few weeds, but, considering the season, these could hardly have been avoided. The paddock was summer fallowed to three inches deep in April, with a Wimmera type of scarifier, then harrowed in April. In June it was re-scarified, and ploughed with a pronged mouldboard plough in August and early September, then harrowed twice. During the first week in November weeds were scarified out and then the land was harrowed. The harrowing was repeated later in November, and again during the first week in December. Summer weeds, such as paddy

melon, which made their appearance, were cut with a "knife" attachment fitted to the scarifier during the first week in February, the harrows were used in March, and then the "knife", again followed by the harrow. It will thus be seen that a considerable amount of labour has been given this paddock, for part of which the abnormal rain has been responsible. The resultant crop, however, should amply recoup Messrs. Bennett Brothers for their trouble. Mr. P. Ryan's No. 2 entry was awarded 96 points and second place, for a fine piece of winter fallow on black soil. The moisture content was not quite so high as that of the winner, and the consolidation of the soil below the mulch not so well effected. The paddock was ploughed in August, to 3 inches, and then harrowed in September. In October it was scarified and harrowed. Sheep were permitted to graze in the summer months. After rain early in December, the soil was harrowed, and finally the weeds were cut with a "knife" attachment early in February, and again late in March. Messrs. Bennett Brothers secured 97 points for their No. 2 entry, red soil. This paddock was summer fallowed in March, to three inches deep, partly with a scarifier and partly with a plough. Subsequently it was worked over no less than fifteen times—largely with harrows. As seen at judging time, it was in almost perfect condition, save that the moisture content, though very good, was not quite so close to the maximum possible as was the black paddock. Mr. W. H. Simms's entry of red soil looked well, though the moisture content was rather less than Messrs. Bennett Brothers' red land. A few weeds were present, though nothing to speak of. The "bottom" was hard and level, and the mulch mellow and of regular depth. Mr. M. Ryan's paddock of red loam, with darker colored patches, was August fallowed; subsequently it was harrowed twice in October, once in December, again in February, and finally spring-fallowed in March, and harrowed. The moisture content was very good, but the consolidation of the under layers was not so good as in the case of the extra well-worked fallows on the same class of soil.

Details of Award. For Best 50 Acres of Fallow.

Competitor.	Soil.	Moisture.	Mulch.	Weeds.	Cultivation.	Total.
Possible points ..	.. .. ..	**25**	**25**	**25**	**25**	**100**
Bennett Bros., No. 1	Black clay loam ..	25	25	23	24	97
P. Ryan, No. 2 ..	Black clay loam ..	24	24	25	23	96
Bennett Bros., No. 2	Red loam ..	22	24	24	25	95
W. H. Simms ..	Red loam ..	21	24	23	24	92
M. Ryan ..	Red loam, black patches	24	23	23	20	90
F. A. Knox ..	Black clay loam ..	21	23	24	21	89
P. Ryan, No. 1 ..	Black clay loam ..	21	21	22	23	87
J. Knox ..	Black and red clay loam	21	22	21	23	87
J. L. Maher ..	Grey sandy loam..	16	21	25	23	85
Petschak Bros. ..	Red loam, black patches	15	22	21	24	82
L. E. Simms	Red loam, grey patches	18	17	21	20	76

PLANTING AND RECONSTITUTION OF VINEYARDS.

Conditions Governing the Distribution of Phylloxera-Resistant Vine Rootlings and Cuttings.

The conditions subject to which Victorian vine-growers may purchase phylloxera-resistant vine cuttings and rootlings (grafted and ungrafted) from the State Vine Nursery, at Wahgunyah, have been drawn up for the current year, and copies of same are available on application.

Beyond certain alterations of dates, the conditions are much the same as for last season. There is no alteration in price.

The last dates before which applications must be made are, respectively: for grafted rootlings (1925 delivery), 31st May, 1924; and for ungrafted rootlings and cuttings (1924 delivery), 30th June, 1924. After these dates applicants can only be supplied in the event of there being a surplus, after all regular applications have been satisfied.

Applicants are required to finally decide, when filling in their application forms, as to their stock and scion requirements; no amendment can be permitted later.

It will suffice here to explain that resistant vines are supplied to intending planters in any of the following forms, and at the prices stated; packing extra, in the case of consignments forwarded by rail:—

Resistant rootlings, grafted with scions previously supplied by applicants, at per 1,000, £12 (Deposit, 30s. per 1,000).

Resistant rootlings, ungrafted, at per 1,000, £3 (Deposit, 15s. per 1,000).

Resistant cuttings, at per 1,000, £1 10s.

APPLICATION FORMS.

No application will be entertained unless made on the forms supplied for the purpose, which are obtainable from the Horticultural Superintendent, Department of Agriculture, 605 Flinders-street, Melbourne, or from the Manager, Viticultural Station, Rutherglen.

Separate forms are provided for (*a*) Grafted Rootlings; (*b*) Ungrafted Rootlings and Cuttings. Applications must be filled in on the proper forms, and accompanied by a deposit as specified above.

Each applicant for forms will be supplied with a copy of the detailed conditions governing the distribution of phylloxera-resistant vine rootlings (grafted and ungrafted) and cuttings.

Applicants are earnestly requested to thoroughly familiarize themselves with these. *They are warned that under no circumstances can any departure be permitted from the regulations governing the distribution as detailed therein, nor can any request for special consideration be entertained.*

DATES BEFORE WHICH APPLICATIONS MUST BE MADE.

For Grafted Rootlings (1925 distribution, June to August inclusive), applications will be received until 31st May next. (For the 1924 distribution the time for receiving applications closed on the 30th June, 1923, and present applicants cannot be supplied until 1925.)

For Ungrafted Rootlings, to be distributed from July to August, 1924, inclusive, applications will be received until 30th June, 1924.

Applications for Cuttings will be received until 30th June, 1924.

A PROFITABLE LITTLE FARM.

By A. J. Gill, Dairy Supervisor.

In gold-bearing districts the soil is usually of poor quality from a grazier's point of view, and the land in and around Bendigo is no exception. Covered here and there by patches of scrub and sparse vegetation, with stone and gravel showing on the surface, it gives one the impression that a cow would find it difficult to gather sufficient food from 50 acres for her subsistence.

Yet in the midst of this barren-looking country is one of the most profitable small farms I have ever had the pleasure of visiting. Its area is 34 acres, covered with a beautiful thick carpet of grasses and clovers, on which sixty cows graze the whole year round. They are fed in the bails for six months, and during the other six depend solely on pasture. The total yield from the herd for the past year was 55,264 gallons, with a test of 4 per cent. This at 1s. per gallon would represent £2,763 4s., or £81 5s. 4d. per acre. Valuing the butter fat at 1s. 6d. per lb., the total return would be £1,657 7s. 2d., or £48 14s. 11d. per acre, without taking the skim milk into consideration.

The yield is remarkable, and is a striking instance of what can be accomplished in Victoria by the use of manure and water, combined with progressive methods, and should convince the most pessimistic that there is a wonderful future in store for this State as more water becomes available, and the land-owners realize what can be achieved by its use.

This farm, which is at present being conducted by Mr. Wallace, is divided into eight paddocks. The manure from the cowsheds is spread over the pasture. Taking the weight of manure as 12 tons per year for each cow, the total weight would be 720 tons, and for the last eight years, until a few months ago, when a small patch was dressed with artificial manure as an experiment, no manure has been brought onto the place from outside.

When Mr. Wallace first took over this land, thirty cows were grazed, and the pasture would usually be up to the cows' knees. The herd was increased to sixty, which keeps the grass and clover down to from 5 to 7 inches long, and on the shorter pasture the cows are milking better. This is an interesting feature, as it is a common mistake made by farmers when grazing off green stuff, to allow the crop to grow too high, and the stalk to harden. Grazed younger, the cows eat it more readily, and waste less, it is easier to digest, and often can be eaten off twice instead of once.

Another point worthy of mention is Mr. Wallace's method of irrigating. Throughout the summer months one man is kept constantly irrigating; the surface soil is thus always kept moist. Mr. Wallace contends that if the ground is allowed to dry, the growth of grass is checked, and it takes a large amount of water to start it again. It is, therefore, cheaper and more satisfactory to keep the soil continually damp. The ground is sloping and the water is allowed to run over it slowly. Though there are so many cows on such a small area, one sees very little manure about, as the continual watering dissolves it and keeps the pasture clean, and the farm has never become what dairymen call "cow-sick".

From November to April the cows depend solely on pasture. In May feeding is commenced; a small quantity is fed at first and increased gradually, until each of the herd is receiving about 14 lbs. of mixed

lucerne and oaten chaff and 5 lb. of bran daily. This is continued till October, when the amount of food is gradually decreased, and ceases at the end of the month.

The management of the farm and cows is good. As the results suggest, the herd has been heavily culled. It is a farm well worth visiting, and Mr. Wallace will be glad to show anyone interested over it.

EFFECT OF LIGHT ON MILK.

The effect of sunlight on milk has been the subject of investigation by two American chemists of Iowa Agricultural College, U.S.A. They have made a comparative study of the effect produced upon the colour, flavour, and bacterial content of milk by placing it in white and in coloured bottles respectively. The results proved that sunlight produces abnormal flavours in milk and cream, whence the necessity of keeping bottles of milk, even in winter, in a special covered chest or under a blanket. Though brown milk-bottles prevent these changes, their use, the investigators state, cannot be advocated, because they make it difficult to see the sediment or the cream line, thus preventing whole milk being distinguished from milk that has been more or less skimmed. Milk kept in brown bottles has also a higher bacterial content than milk in ordinary bottles, which is in part due to the higher temperature of the brown bottles, and also to the fact that light has a decided influence in keeping down the number of bacteria in white bottles. In fact, if part of the same milking is exposed to sunlight in ordinary bottles and the rest kept in the dark in similar bottles, it will be found that the bacterial content is lower in the exposed milk, although the temperature is higher.

From the general results of their observations the investigators have drawn the following conclusions:—

Sunlight has a pronounced influence on the flavour of milk and cream; with sufficient exposure a definite tallowy flavour was produced, and with less exposure a distinct sour flavour developed.

Sunlight is observed to produce an abnormal flavour, sometimes tallowy and sometimes otherwise, in other dairy products, such as ice cream, evaporated milk, skim milk, and starters. When milk or cream has acquired a tallowy flavour from exposure to light, it is communicated to the butter, which does not lose it by keeping.

When there was an increase in acidity in milk exposed in ordinary bottles and brown, the increase was generally greater in the brown bottles.

The colour of milk exposed to sunlight does not alter nearly as much in brown as in colourless bottles, in which the milk after a time shows a chalky dead-white appearance and produces butter of much lighter colour. Light has a greater influence on a milk low in fat content than on a milk with a high fat content.

Exposure to air had evidently some influence on the development of a tallow flavour.

The tallowy flavour in milk exposed to sunlight in white bottles apparently decreased somewhat as a result of storage at low temperature.

WHEY AND SKIM MILK FOR BREAD-MAKING.

It has been common knowledge for a long time that the quality of bread is improved when whey or skim milk is used in the baking instead of water. On the other hand, it has not been made quite clear that the yield of bread is increased to such an extent, that the use of whey and milk in bread-making for that reason alone will pay.

Experiments regarding the question have just been concluded at the Government's Experimental Station, Christiania. The experiments embrace altogether 160 individual makings of bread carried out at different seasons and at different bakeries all over Norway. At the same time a series of analysis have been performed of bread made with water, with whey, and with milk, as well as analysis of whey by itself.

The use of whey gave as a result average saving in flour of 4.2 per cent., as against 6.2 per cent. when using skim milk. The extra yield of bread was 9.9 kilos per 100 kilos of whey, and 14.4 kilos per 100 kilos of skim milk. Comparing these results with the utilization of milk and whey for other purposes, it appears that bread-making, at the now ruling prices, yields a higher gross profit than cheese-making and "Myse" cheese-making (Norwegian whey cheese), and as regards whey, it will in bread-making also show a better return than when employed in bacon manufacture (pig feeding).

When one considers the higher cost in the case of bacon manufacture and cheese-making as compared with bread-making, the utilization of whey in the latter instance will appear still more profitable.

Comparing whey and milk (skim), apparently the former is the more profitable of the two, especially if it is remembered that, taking the nutritive value into consideration, whey in most cases is cheaper to buy than skim milk.

If comparisons are drawn between the different modes of utilization of whey and milk on the basis of calorie-units, it will appear that 100 kilos of whey provide nearly three and a half times—and skim milk about two and a half times— the value in calories in bread-making and cheese-making, than is the case in bacon manufacture. Bread and whey cheese-making, however, are not only superior to bacon manufacture as regards calorific value. Another advantage of the former is that all danger of infection from the milk or whey is eliminated by the high temperatures employed during the process of baking resp. cheesemaking.

The use of whey and milk for baking purposes is not only remunerative because of the greater yield of bread, but the quality of the bread is considerably improved thereby. All of the 160 makings which were carried out, were judged by a specially elected committee of experts (bakers). According to their report, whey-bread and milk-bread range in quality considerably over bread made with water. The fermentation in the former is better. They are better baked, have a more porous body, and keep longer without going dry. Besides, the whey-bread is more voluminous than water-bread of even weight.

Also from a nutritive point of view, whey-bread and milk-bread have advantages over water-bread, as part of the vegetable substance of the flour is substituted by the animal food values of milk.

Bakers have often urged as an objection against whey, that it is frequently sour and consequently less suitable for baking. This, however, must be due to misunderstanding. In the modern creamery the casein is separated from the milk by means of rennet, and in consequence, the whey is always ready for delivery an hour or two after the milk has been handed in by the producer.

It is obvious that the price demanded for whey and milk is the deciding factor as far as the bakers are concerned. But there is good reason for the belief that the creameries and bakers can agree on a price which is sufficiently moderate for the bakers to see their advantage in using whey and milk without having to increase the price of bread. But even, should it necessitate a small increase in the bread price, the gain of getting a better baked bread of improved flavour and greater nutritive value is so important that the consumer will soon find out that it is to his advantage to buy it.

Experiments are now being carried out with a preparation of concentrated whey in which the whey is boiled down to half its volume.

[Reprinted from *Hansen's Dairy Bulletin* (Eng.), Jan., 1924.]

FEEDING AND MANAGEMENT OF DAIRY COWS.

Quick v. Slow Milking.

Dr. C. Crowther, of the Harper-Adams College, in an instructive address to the Shropshire (Eng.) Chamber of Agriculture on the feeding and management of milking cows, detailed the foods necessary for the maintenance of a cow, and also for the production of a gallon of milk (says *The Dairy*). Taking a 1,000-lb. weight animal as a basis, a dry cow required 6 lb. of starch values, the unit now generally adopted, including 0.6 lb. of digestible albuminoids. For a dry cow in calf, he would increase the starch values by 1 lb., and the albuminoids by a third of a pound.

In the case of a cow in milk, 2½ lb. of starch values, which should contain 0.6 lb. of albuminoids, should be added for each gallon of milk produced. Milk also contained lime and phosphoric acid; but on ordinary rations he did not think any serious risk would be run of keeping the cow short of lime until they got into the region of high yields.

There were six main points to be kept in mind: (1) The ration must be a bulky one; (2) the amount of albuminoids; (3) the palatability of the material; (4) any possible effect of the food on the produce; (5) any cumulative effect of the food on the cow; (6) the cost of the food.

Expert Milking.

Figures as to the remarkable difference in the milk of a cow when milked by an expert and a novice were given by Dr. Crowther, who said the results of tests he made in 1904 were so extraordinary that he had never dared to publish them. Four cows were milked on alternate days by an expert milker and a novice. One cow, on the days she was milked by an expert, averaged 11.3 lb. a day, but when milked by a novice she only averaged 9.4 lb. The average proportion of fat obtained by the expert was 4.2 per cent., against 2.5 per cent. by the novice. In the other cows the difference in the yields was equally striking.

In later experiments, he found the great importance of quick milking against slow milking, and obtained most extraordinary results, especially in the amount of fat. In one experiment he found that by quick milking 10 per cent. more milk and 30 per cent. more fat were obtained.

Observations of that kind, he said, brought out that skilful milking was almost the key to the situation. It was no use spending a lot of time and money in getting good cows and devising scientific rations unless they had efficient milking. A bad milker would do more harm by his clumsy and incorrect methods of milking than the farmer would by neglecting scientific feeding.

SALT FOR DAIRY COWS.

The feeding of salt to cows forms the subject of an interesting article by Mr. L. P. Pugh in a recent issue of the *British Friesian Journal*. There seems to be a widespread opinion, he states, that the majority of heavy milking Friesians must become sterile owing to the tremendous "strain" on their constitution brought about by repeated pregnancy and heavy lactation. There is an element of truth in this opinion, although not nearly as much as is sometimes suggested by persons who are perhaps not entirely disinterested. Indeed, if we were to accept their views, we should have to believe that the Friesian herds were doomed to extinction in a few generations.

Breeders sometimes seem to think that their cattle form an inexhaustible store, and can be drawn upon indefinitely, he continues, and are apt to forget that the normal food of a cow is such as to supply normal requirements. The requirements of milking records are much above the normal, and unless the diet be carefully added to, will soon exhaust the best cattle. As is well known, milk contains proteins, fats, carbohydrates, and salts. The first three depend upon the

amount of recognised "foods" available, and can be controlled with comparative ease. But salts are not commonly recognised as "foods," nor is attention given to the question as to what salts are required. "Common salt" is sodium chloride, but this is only one of those of which the animal stands in need. We must certainly add calcium salts and phosphates, for these are the most important constituents of bone.

Pregnancy entails a considerable drain on the calcium salts of the mother, in order that the bones of the calf may be formed. Lactation has to keep up the supply of calcium which is still being deposited in the bones of the calf. Few people realize what an enormous drain on the mother this entails. It is well known, however, that this strain is often followed by nymphomania, and that this in turn is not infrequently associated with fractures of the pelvis. It is true that some slight injury may produce the fracture, but it never could have been done if the bones had not previously been drained of their calcium and phosphates for the benefit of the calf. On these grounds alone, there is good cause for advocating more attention to the details of salt feeding, but we have also the fact that inorganic salts are well known to be essential to the mechanism by which the body overcomes infection. Infection is probably far and away the most frequent cause of sterility, so that any measures which can assist in combating it are of great importance and interest to breeders.

The calcium salts appear to be of most importance in the defence against infection, but to meet the drain on the body occasioned by pregnancy and lactation, we must add salt of phosphorus and magnesium. These can conveniently be procured as the phosphates of calcium and magnesium. It is very questionable whether the more expensive hypophosphates offer any real advantage over the simple phosphates. Therefore, at the present state of our knowledge, it should certainly be good practice to allow all heavy milking cows a liberal amount of steamed bone flower or meal (1 lb. per day) mixed in their ordinary feed, with the addition of a plentiful supply of common salt both in their feed and in the form of licking blocks.

SOME NOTES ON ALMOND AND WALNUT GROWING.

Almonds are better suited to our inland than our coastal districts; they do not crop satisfactorily on the coast, and the husk has a tendency to cling to the shell instead of cracking off as the nut ripens. On the tablelands late frosts affect the cropping, the almond blossoming very early, and here also the husk often fails to crack away from the shell.

The almond has principally been grown as a wind-break for other trees, although in the Junee and Young districts a few small areas are planted entirely with almonds. In normal seasons the rainfall in these districts is sufficient for the requirements of the trees. During drought years the crop is affected, though the trees are very hardy, and provided they are not attacked by white ants, drought will not kill them. In the drier districts farther west, irrigation is necessary. The deep granite inland soils suit the almond well.

It is most important to provide for cross-pollination, for most varieties of almond fail to crop if grown by themselves. Estimates of returns obtained from almonds in departmental orchards are difficult to arrive at, the trees there only being planted as wind-breaks, but the average net return was worked out a few years ago at not more than £17 per acre. Growers state that on the lighter soils of the Murrumbidgee Irrigation Area the returns from almonds are sufficient to warrant their being planted in blocks.

The walnut has not been grown extensively in New South Wales, though a few trees are to be observed on many holdings in our tableland districts. It requires a deep, well-drained soil. Deep river loams, or loams made up of accumulated washings of soil from higher land, are specially suited to the crop. Although the walnut requires good drainage, it will not crop satisfactorily if it is starved for moisture. Often the tree will have sufficient moisture to form and mature its crop of nuts, but a dry period at the end of the summer and early autumn will seriously affect the next season's crop.

None of the departmental orchards is suited to the walnut. A large number of trees were tried at Yanco Experiment Farm under irrigation, but the conditions there were not suitable, and departmental data on which to form an idea of the prospects of walnut-growing are therefore lacking. One difficulty is to secure a plantation of trees of uniform cropping habit. It will often be noticed in a clump of three or four trees that one will be a heavy cropper and the others poor.

HENS THAT LAY TWICE DAILY.

At one time it would scarcely be believed that a hen could lay two normal eggs in one day, but since the establishment of single-pen testing many hens have been discovered that occasionally lay twice daily. Over-stimulation is a probable cause of the phenomenon, which simply means that two yolks leave the ovary cluster in one day, and are dealt with perfectly.

NOTES ON PEA-NUT GROWING.

Though not a crop of major importance, pea-nuts may very profitably engage some of the attention of the irrigation farmer. In itself the plant is a very valuable soil renovator, and decidedly useful as fodder, especially perhaps for pigs, but there is also the confectionary trade, and there are the pea-nut oils and other products of the nut which already represent many millions of dollars annually in the United States, and which are beginning to receive attention from manufacturers in this country. Australia might well be growing all its own requirements and even exporting a surplus, and growers have the advantage of the protection of a substantial Tariff wall.

Pea-nuts should be grown on the lighter class of soils, as the nuts (which are formed under the soil surface) must have room for expansion. The preparation should be deep, affording the plants 5 or 6 inches of worked soil, and the sowing should be made in the middle of October in drills 2 ft. 6 in. to 3 feet apart, and with 12 to 24 inches between the seeds, according to variety. The variety known as Local is of spreading vegetative habit, and requires a good deal more space than Spanish, which is the smallest plant of those grown here. Valencia comes between the two.

The water must be applied in furrows, the interval between waterings at the early part of the season being about a month, but in the hot weather of midsummer and early autumn it should be about a fortnight, the object being to keep the crop growing with frequent judicious waterings. The water must be so managed that it does not lie long on the crop, and toward the end of the season the effort must be to encourage the plants to mature in March, otherwise a series of nuts will be set until it is so late in the season that the bulk of the crop may be damaged by waterings which are intended to mature the late crops.—*Agricultural Gazette of New South Wales.*

TOBACCO GROWING IN SOUTH AUSTRALIA.

No feature associated with the tobacco crop in South Australia this year is more encouraging than the very satisfactory development of the plants in seed-beds. In the neighbouring States of Victoria and New South Wales the area planted to tobacco was very much less than would otherwise have been the case because of the shortage of plants occasioned by the development of the fungous pest known as blue mould. This serious pest, so far as can be ascertained, did not appear in any of the seed-beds in South Australia this year. On the contrary, the germination and subsequent growth were such that in each case referred to above the growers had many more plants than were necessary to cover the area which they contemplated planting.

In the fields, likewise, the tobacco is free from disease, and, with the exception of very slight damage done by caterpillars, has suffered little damage from insect pests.

TO PURIFY WATER IN A TANK.

An inquiry was received recently as to the best method of preventing the formation of green slime on well water that has been pumped into an iron tank. "The water is clear and fresh," wrote the correspondent, "and I wash the tank out frequently, but within a few days this green slimy stuff appears, and gets along inside the pipes, causing considerable trouble. Kindly advise if these is any uninjurious chemical, or what method I could adopt, to prevent the growth. The water is used for domestic purposes."

The writer was advised to clean out the tank and cover it so as to exclude the light. Simple aeration of the water in the tank by blowing air into it would tend to prevent the abundant development of the algæ (vegetable growths) with their objectionable tastes and smells. The following methods were suggested for chemical purification and elimination of algæ, &c.:—

1. Bleaching powder, used at the rate of 2 to 2½ oz. per 1,000 gallons of water. The chloride of lime should be mixed in a bucket with water, and the contents added to the water in the tank, and stirred through the mass.
2. Prepare a fairly strong solution of permanganate of potash in water. Add this in small quantities at a time to the water in the tank, stirring well after each addition until the bulk water acquires a very faint pink colour. The final depth of colour may be observed in a tumbler.
3. Copper sulphate (bluestone) is a highly effective algicide, and is extensively used in large water reservoirs, but the amounts used must be very accurately measured. It should be used at the rate of one part bluestone to six million parts water, or 12 grains (actually 11.7) per 1,000 gallons.

In using any of the above methods, two tanks may be employed, in one of which the purification process would be proceeding while the other was being used for any necessary purpose.—*Agricultural Gazette of New South Wales.*

ORCHARD AND GARDEN NOTES.

E. E. Pescott, F.L.S., Pomologist.

The Orchard.

CULTIVATION.

Cultivation work should be well on the way by this time. The ploughing should be advanced, so as to leave plenty of time for other orchard work. Autumn ploughing may be rough, but care should be taken to plough to the trees, so that a drainage furrow is left between the rows.

MANURING.

It is just possible, where heavy crops have been carried, that a top dressing of stable manure will be required to add humus to the soil. The fertility of the soil must be maintained; and, although stable and chemical manures as a general rule are of undoubted value as tree stimulants, well-cultivated and thoroughly tilled land will always carry fair crops with far less manure. Further, if the orchard land is well drained, cultivated, and sub-soiled, any manures that are used will be far more beneficial to the trees. The more suitable the conditions that are given to the trees, the better they can appreciate and assimilate their food.

Perhaps the most useful and valuable of manures is stable manure. It is of great use, not only as a manure and as an introducer of necessary bacteria into the soil, but its value in adding humus to the soil is incalculable. Organic matter, such as stable manure, introduced into the soil quickly becomes humus; this greatly ameliorates and improves soil conditions. It is impossible to say what quantity of stable manure is necessary per acre; that can be determined only by circumstances. Orchards in different climates and varying soils will require differing quantities. A too liberal use of stable manure will be over-stimulating in most cases, and at all times an excess beyond what is necessary for present use will only be waste, as humus is readily lost from the soil, once it is in an available food form.

It has been pointed out in these notes previously that an improved physical condition is far more profitable to the fruit-grower than the continued use of manures. A tree will be far more productive if it is happy in its soil conditions; uncomfortable conditions will always result in unprosperous trees.

A dressing of lime, using about 4 or 5 cwt. per acre, is of great value in stiff or heavy orchard lands; and it may be given at this season. The lime, which must be fresh, should be distributed in small heaps between the trees, covered with a layer of soil, and allowed to remain for a few days before ploughing or harrowing in.

Pests.

The advice given last month for spraying should be followed, particularly where any oil emulsions or washes are to be used.

Orchards will benefit if an attack is now made upon the Codlin moth. All hiding places, nooks, and crannies, where the larvæ have hidden, should be thoroughly searched and cleaned out. The orchardist has far more time now to do this work than he will have in the spring time.

General Work.

Drainage systems should now be extended with as little loss of time as possible.

New planting areas should be prepared, and sub-soiled or trenched wherever possible.

The Vegetable Garden.

Weeds must be kept down in the vegetable garden. Weeds are generally free growing at this season; their growth is very insidious, and they will crowd out the young seedlings or plants in a very quick time. Hoeing and hand weeding must be resorted to, preferably hoeing. The frequent use of the hoe in winter time is of much benefit in the vegetable garden. A varied assortment of crops is now being produced; and if these can be kept growing much better crops will result. The soil quickly stagnates in the winter, and the only way to prevent this is to keep the surface stirred. Thus, a double service is performed with the aid of the hoe.

The application of lime is of great necessity at this season. In addition to amending unhealthy and unsuitable soil conditions, lime is particularly useful as an insecticide. It assists in destroying in immense numbers both eggs and insects that would breed and live in the ground ready to do damage to all classes of vegetable crops. Therefore, wherever possible, the soil should receive an application of lime. The garden should, as well, be manured with stable manure, but not for some weeks after the lime application.

Cabbage and cauliflower plants may be planted out; and seeds of parsnips, carrots, onions, peas, and broad beans may be sown.

The Flower Garden.

The whole flower section should now be thoroughly dug over. All beds should be cleaned up, top dressed with manure, and well dug. The light rubbish, such as foliage, twiggy growths, weeds, &c., may all be dug in, and they will thus form a useful addition to the soil. These should never be wasted. Only the coarser and stouter growths should be carted away for burning, and then the ashes may be used as manure. No part, whatever, of garden rubbish or litter need be wasted. In one form or another it should be replaced in the soil.

May is a good month for establishing new gardens, and for planting out. All deciduous plants and shrubs may now be planted. It is not necessary to dig a deep hole for planting. A hole in which the roots of the plant can be comfortably arranged, without crowding or cramping, will be quite sufficient for the purpose.

Continue to sow seeds of hardy annuals, including sweet peas, although the main crop of sweet peas should by this time be well above ground. Where there has been any overplanting, the young plants will readily stand transplanting, and this will greatly assist those that are to remain. Annuals should not be crowded in the beds. They require ample room for suitable development, and thus the seeds should be sown thinly or the plants set out a good distance from each other.

All herbaceous perennials that have finished blooming may now be cut down. Included amongst these are phlox, delphiniums, &c. If these are to remain in their present situation for another season it is always an advantage to raise them somewhat, by slightly lifting them with a fork, so that too much water will not settle around the crowns; they may also be mulched with stable manure, or the manure may be forked into the soil around the crowns.

REMINDERS FOR JUNE.

LIVE STOCK.

HORSES.—Those stabled and in regular work should be fed liberally. Those doing fast or heavy work should be clipped; if not wholly, then trace high. Those not rugged on coming into the stable at night should be wiped down and in half-an-hour's time rugged or covered with bags until the coat is dry. Old horses and weaned foals should be given crushed oats. Grass-fed working horses should be given hay or straw, if there is no old grass, to counteract the purging effects of the young growth. Old and badly-conditioned horses should be given some boiled barley. Paddocked horses should be looked at from time to time to ascertain if they are doing satisfactorily.

CATTLE.—Cows, if not housed, should be rugged. Rugs should be removed and aired in the day-time when the shade temperature reaches 60 degrees. Give a ration of hay or straw, whole or chaffed, to counteract the purging effects of young grass. Cows about to calve, if over-fat, should be put into a paddock in which the feed is not too abundant. If in low condition feed well to tide them over the period and stimulate milk flow. It should be borne in mind that the cows most liable to milk fever are those that have been low in condition and are rapidly thriving. The treatment described in the *Year-Book of Agriculture*, 1905, should be almost invariably successful. It will generally be found most profitable

to have cows calve in autumn. They will then pay well for feeding through the winter, and will flush again with the spring grass. Calves should be provided with warm dry shed. Cows and heifers for early autumn calving may be put to the bull. Observe strict cleanliness and regularity with regard to temperature and quantity of feed to avoid losses and sickness incidental to calf rearing.

PIGS.—Supply plenty of bedding in well-ventilated sties. Sows in fine weather should be given grass or lucerne run. Bulletin on the Pig Industry is now available.

SHEEP.—Clear muck-balls from tails and legs of all sheep. Have the wool cleared from round udders and eyes of all young lambing ewes, and see them first thing every morning. Mark the ram lambs at earliest chance, providing they are strong and the season assured. Cut off ewes with oldest wether lambs to best pasture available.

Sheep with overgrown hoofs are unthrifty. Whenever noticed trim back into shape; they cut easily during winter. If left, are conducive to lameness, and even foot-rot. In the case of common foot-rot, or scald, the feet can be placed in a thick paste made of lime and hot water. Obstinate cases of long standing may need more drastic remedies, and persistent attention. In all cases pare away all loose portions, and leave the diseased parts clearly exposed.

Foxes are more ravenous during winter months. Sparrows, starlings, and parrots are good bait. Poisoning lambs already killed usually accounts for scavenger foxes only.

Every fox is not a lamb killer. Remove all lambs for two or three nights if at all possible, and birds then will rarely fail to entice Reynard the second or third night.

Powdered strychnine, just sufficient to cover nicely a threepenny-piece, is the usual dose. On the more valuable stud lambs fix a light tin collar, cut from 2 inches wide at the top of the neck to 3 inches wide below, fastened underneath in one place only, near the breast, with fine wire, and lying open towards the throat, allowing the lamb to both suck and feed. It should be cut as large as possible, yet not large enough to permit of its falling off over the lamb's head. This makes a guard that rarely fails to prevent a fox getting to the main blood vein. Remove the guards when the lambs are about eight weeks old.

POULTRY.—Supplies of shell grit and charcoal should always be available. Sow a mixture of English grass and clover; this not only removes taint in soil but provides excellent green fodder for stock. Where possible, lucerne and silver beet should now be sown for summer feed; liver (cooked) and maize aids to egg production during cold weather. Morning mash should be mixed with liver soup given to the birds warm in a crumbly condition. All yards should be drained to ensure comfort for the birds.

CULTIVATION.

FARM.—Plough potato land. Land to be sown later on with potatoes, mangolds, maize, and millet should be manured and well worked. Sow malting barley and sow cereals. Lift and store mangolds, turnips, &c. Clean out drains and water furrows. Clean up and stack manure in heaps protected from the weather.

ORCHARD.—Finish ploughing; plant young trees; spray with red oil or petroleum for scales, mites, aphis, &c.; carry out drainage system; clean out drains; commence pruning.

VEGETABLE GARDEN.—Prepare beds for crops: cultivate deeply; practise rotation in planting out; renovate asparagus beds; plant out all seedlings: sow radish, peas, broad beans, leeks, spinach, lettuce, carrot, &c.; plant rhubarb.

FLOWER GARDEN.—Continue digging and manuring; dig all weeds and leafy growths; plant out shrubs, roses, &c.; plant rose cuttings; prune deciduous trees and shrubs; sow sweet peas and plant out seedlings.

VINEYARD.—Thoroughly prepare for plantation, land already sub-soiled for the purpose. Remember that the freer it is kept from weeds from this forward, the less trouble will there be from cut-worms next spring. Applications for grafted resistant rootlings and cuttings must be made before the end of the month—see current issue. Pruning and ploughing should be actively proceeded with. In northern districts plough to a depth of seven or eight inches. Manures should be applied as early as possible.

Cellar.—Rack all wines which have not been previously dealt with. Fortify sweet wines to full strength.

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Useless Swamps Converted into Valuable Pasturage

(Worth £50 an Acre)

By the Wonderful Water Meadow Grass

POA AQUATICA

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Landowners having swamp lands which are damp all the year round should turn them to better use by POA AQUATICA as it requires no drainage or cultural preparation

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POA AQUATICA.—(1) Is a perennial grass, growing 6 to 7 ft. in height. (2) Is easily propagated by root planting. (3) Spreads rapidly. (4) Has good fattening properties, and suitable for dairy herds. (5) Unharmed by floods. (6) Will never become a nuisance by extending into cultivated land. (7) Improved by trampling and close feeding.

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POA AQUATICA PLANTED OUT BY ROOTS.—(1) Reclaims the swamps by overpowering and suppressing all sedges, rushes, water lilies and mosses by means of its long, strong underground creeping, as well as fibrous roots and luxuriant vegetation. (2) Produces an enormous bulk of succulent feed. (3) Obliterates dangerous bogs and makes the swamp surface everywhere safe for stock. (4) Converts useless swamps into valuable pasturage. (5) Obviates expense of draining.

PLANT 3 BAGS PER ACRE.

Roots of Strong, Good Quality, 35/- sack; ½-sack, 20/-

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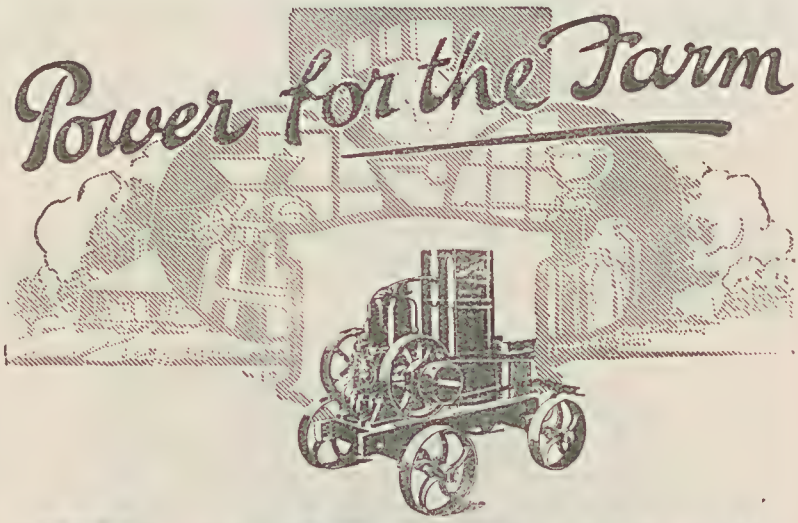

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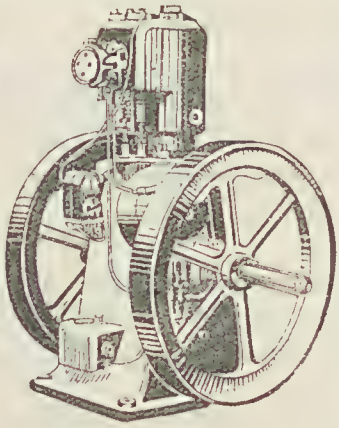

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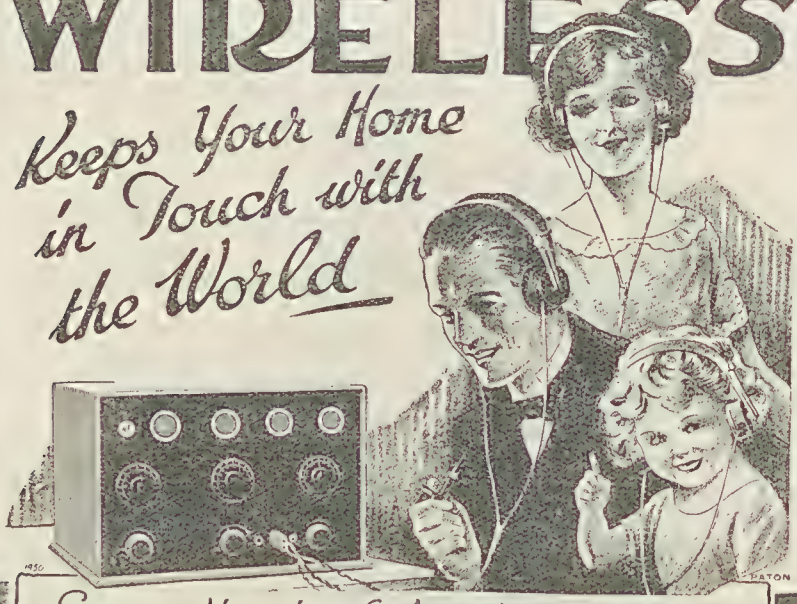

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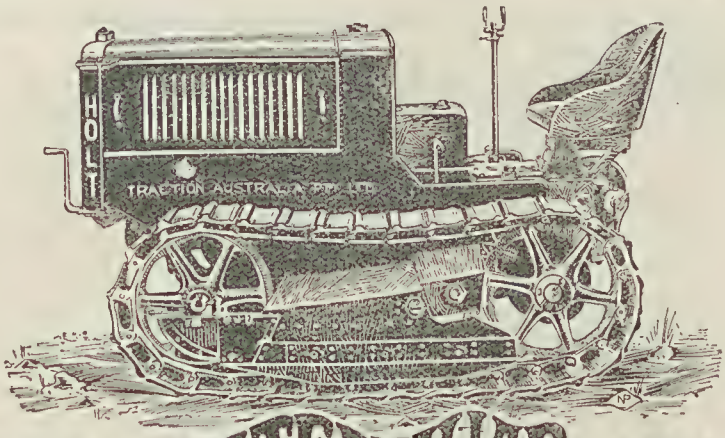

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FRIESIANS FOR SALE

(1) Bull Calf *ex* Dominion Hyacinth (374)

Dropped 29th August, 1923

Sire: **Victoria Songboy (359)** by Dominion Domino Dutch Boy (73 F.H.B.A.), *ex* Dominion Madrigal (371 F.H.B.A.).

Sire of Dam: **Oak de Kol 2nd Homestead Fobes** (imp. to N.Z. from America) (341 N.Z.F.H.B.).

Dam's Record for 273 days under Government Herd Test—
11,512 lbs. Milk, 4·08 Test, 479 lbs. Butter Fat.

For Full Lactation Period—
13,898 lbs. Milk, 4·24 Test, 589 lbs. Butter Fat.

(2) Bull Calf *ex* Victoria Oakdale Lassie (996)

Dropped 24th September, 1923

Sire: **Victoria Jo Patch (345)** by Longbeach Big Patch (515 N.Z.F.H.B.), *ex* Dominion Madrigal (371).

Sire of Dam: **Dominion Oakdale (342)** by Oak de Kol 2nd Homestead Fobes.

Vict. Oakdale Lassie is now undergoing her 1st test.

Her Dam, Dominion Proud Lassie's Record for 273 days under Government Herd Test—
11,336 lbs. Milk, 3·42 Test, 387 lbs. Butter Fat.

For Full Lactation Period—
12,216 lbs. Milk, 3·51 Test, 428 lbs. Butter Fat.

(3) Bull Calf *ex* Dominion Woodnymph (988)

Dropped November, 1923

Sire: **Victoria Jo Patch (345)** by Longbeach Big Patch (515 N.Z.F.H.B.), *ex* Dominion Madrigal (371).

Sire of Dam: **Woodcrest Jo** (imp. to N.Z. from America) (334 N.Z.F.H.B.).

Dam's Record for 273 days under Government Herd Test—
10,610 lbs. Milk, 3·17 Test, 336 lbs. Butter Fat.

For Full Lactation Period—
13,240 lbs. Milk, 3·31 Test, 439 lbs. Butter Fat.

The record of the dam—DOMINION MADRIGAL—of the sires "Victoria Songboy" and "Victoria Jo Patch" for 273 days under Government Herd Test is 11,373 lbs. Milk, 3·93 Test, 448 lbs. Butter Fat; and for Full Lactation Period 13,485 lbs. Milk, 4·17 Test, 563 lbs. Butter Fat. "DOMINION MADRIGAL" is a full sister to "DOMINION QUEEN MERCEDES," third cow of all breeds under Government Herd Test 1923, and Winner 'Weekly Times" Butter Competition, Melbourne Royal Show 1923, and Champion Melbourne Royal Show 1923.

(4) Cow "VICTORIA DUTCHMAID," 4 years old, due to calve on 17th April.
Sire: Dominion Domino Dutch Boy (73). *Dam:* Dominion Milkmaid (370).

(5) Heifer "VICTORIA BELLONA," 3 years old, due to calve in May.
Sire: Dominion Domino Dutch Boy (73). *Dam:* Dominion Belle Corona (369).

(6) Heifer "VICTORIA CORIANDER" 3 years old, due to calve on 1st April.
Sire: Dominion Domino Dutch Boy (73). *Dam:* Dominion Coringa (380).

Inspection of above Bull Calves and Heifers at the State Research Farm, Werribee, is invited.

Application for Purchase to—

DR. S. S. CAMERON, Director of Agriculture, MELBOURNE

DEPARTMENT OF AGRICULTURE, VICTORIA

Red Poll Dairy Herd

The Department has now completed the orders for calves that were booked ahead of calving when the advertisement was withdrawn; consequently the booking of orders for bull calves from the forthcoming calvings has now been resumed.

BULL CALVES are sold for delivery at a month old at prices based approximately on the actual milk and butter fat record of the dam at the rate of 1s. per lb. of butter ***fat*** yielded. Thus a calf from a cow with a 400 lbs. butter fat record is sold for 20 guineas, one from a 300 lb. butter fat cow for 15 guineas, and so on. Bull Calves *ex* heifers on their first calf are sold for a set price of 10 guineas.

(For Record of Yields of dams see Red Poll Herd Book.)

The Bulls in Use include—

VICE REGAL (95 A.A.)

Sire: Nicotine (69 A.A.). Dam: Velveteen (Imp.) 22875 (2 A.A.).

VICTORIA VOLCANO (322 A.)

Sire: Nicotine (69 A.A.) by Acton Dewstone (imp.) 9524 (4 A.A.).
Dam: Tonga (253 A.) by Honingham Archbishop (imp.) 9702 (48 A.A.).

Tonga's butter fat yields for 6 successive lactation periods are as follow:—1916, 341 lbs.; 1917, 398 lbs.; 1918, 419 lbs.; 1919, 479 lbs.; 1920, 428 lbs.; 1921, 562 lbs.

BELLIGERENT (Imported) 11096 (8 A.A.)

Dam's Record (1st milking) 7144 lbs. milk.

Dam's	Dam's	,,	14533 lbs. milk	...	4	years average	12871 lbs. milk.
Sire's	Dam's	,,	10370	,,	...	7	,,	,,	9354	,,
Sire's D.	Dam's	,,	9510	,,	...	12	,,	,,	8033	,,
G. Sire's D.	Dam's	,,	10215	,,	...	7	,,	,,	9386	,,
G.G. Sire's D.	Dam's	,,	12565	,,	...	10	,,	,,	8853	,,
G.G.G. Sire's D.	Dam's	,,	10088	,,	...	2	,,	,,	9754	,,

Inspection of the Herd is Invited.

Visitors will be met at the Station on notifying the Manager, State Research Farm, Werribee.

Application for purchase to

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Climatic conditions required are a fairly regular Autumn to Spring rainfall. It should do well, in this State, in all parts where the rainfall exceeds twenty inches.

Its main use is for grazing green, or when matured as a dry feed. In addition it is a great soil improver and of great value in choking out undesirable weed growth.

It is only an annual, but as it produces most of its seed just below the surface of the soil (hence its name) it is in practice perennial, and once introduced and properly established it is permanent.

We recommend sowing in all mixtures of grasses at the rate of ½ lb. to 1 lb. per acre. Sown with cereal crops 2 lbs. per acre should be sufficient, while, if sown alone on properly prepared land, from 4 lbs. to 6 lbs. and even up to 10 lbs. per acre may be planted according to the quality of the land. Smaller sowings may be made if time is allowed for the Clover to spread, which it does very rapidly. Price on application.

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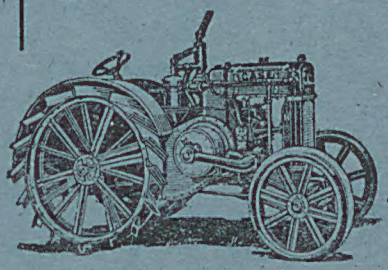

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